"A STUDY ON FUNCTIONAL OUTCOME ANALYSIS OF UNCEMENTED TOTAL HIP REPLACEMENT"

Dissertation submitted

To

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY, CHENNAI

In partial fulfilment of regulations for the award of the degree of

M.S.(ORTHOPAEDIC SURGERY)

BRANCH-II

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation tittled**"A STUDY ON FUNCTIONAL OUTCOME ANALYSIS OF UNCEMENTED TOTAL HIP REPLACEMENT"** is a bonafide and genuine research work carried out by me under the guidance of **PROF. DR. R.BALACHANDRAN.M.S.(Ortho).,D.Ortho.,** in the Department of Orthopaedics, Government Royapettah Hospital, Chennai.

This dissertation is submitted to THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY, CHENNAI in the partial fulfilment of the university regulations of the Tamil Nadu Dr M.G.R Medical University, Chennai for M.S. Orthopaedic Surgery examination to be held in April 2015.

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CERTIFICATE

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TOPIC:

FUNCTIONAL OUTCOME ANALYSIS OF UNCEMENTED TOTAL HIP REPLACEMENT

AIM:

To analyze the functional and radiological outcomes of total hip Replacement.

BACKGROUND

Cemented total hip arthroplasty was the ideal mode of joint replacement. but bone cement is the weakest link between the implant and bone. Subsequently failures of cemented total hip arthroplasty were seen due to various reasons like micro fractures of cement mantle under torsional loading, loosening due to particulate induced osteolysis, bone loss with difficulty in future revision. The above mentioned adverse effects of bone cement led to the popularity of uncemented total hip arthroplasty. Here porous and hydroxy apatite coated components are used. This creates a biological interface called bone in growth. Thus uncemented total hip arthroplasty today has become, the main mode of hip replacement especially in young patients.

MATERIALS AND METHODS

This study was conducted at Government Royapettah Hospital, Chennai, consisting of 30 patients for various indications in the age group of 20 -60 yrs. Appropriate preoperative planning was done and correct acetabular and femoral component was selected. A standard protocol was used in the post operative period. Follow up visits are made at 3 month, 6 month, 1 year and periodically thereafter. Routine X-rays are taken at 1-2 year . Post operatively Radiological assessment done for femoral component and acetabular component. Functional assessment done with Modifed Harris Hip Score.

RESULTS

Radiologically Majority of the femoral stem had shown good osteo integration with bony in growth. In majority of cases acetabular cup seated correctly without polar gaps and in optimal inclination. Anterior thigh pain in 2 cases and limb length discrepancy in 5 cases and intra operative femur fracture in 1 case were the encountered complications.

CONCLUSION and DISCUSSION

Restoration of the biomechanics of the hip is important for the good outcome and longevity of the prosthesis **.** Patients with chronic arthritis are incapacitated by pain and restricted motion and thus the relief of these two factors greatly determines the satisfactory outcome of the surgery. Uncemented Total hip arthroplasty is mainly indicated in young patients with adequate bone stock. Careful patient selection along with pre op and post op evaluation of both patients and radiographs is essential for the success of total hip arthroplasty.

CONTENTS

INTRODUCTION

Total hip replacement is commonly performed adult reconstructive surgery. The contributions of Charnley in total hip replacement have improved the quality of life for many patients . Research about total hip replacement continues for the benefit of needed patients.

The goals of total hip replacement are to provide motion and to relieve pain and to correct the deformity while maintaining stability. Total hip replacement can either be uncemented or cemented.

In earlier days cemented total hip replacement was commonly done. But failures were encountered due to loosening of the implant because of micro fractures of cement mantle and osteolysis induced by cement particles. The noted complications of bone cement used include sudden myocardial depression and hypotension and pulmonary embolism.

In response to the aforementioned disadvantages of using cement, uncemented total hip replacement has been popularized. Here porous and hydroxyl apatite coated components have been used for durable skeletal fixation. In this method biological interface known as bone in growth is created and so this fixation becomes strong and permanent.

Absence of micro motion and intimacy of porous surface and the pores with diameter of > 40mm are criteria for bone in growth.

Uncemented total hip replacement has some disadvantages of excessive wear, periprosthetic bone loss and inadequate initial fixation. Techniques to overcome these disadvantages have been investigated and evolved including use of highly cross linked polyethylene to reduce wear and use of super alloys.

The paramount importance for the success of total hip replacement mainly depends on appropriate patient selection and the use of correct implants and the methodological performance of the surgery.

Hence in Orthopedic surgery department, Government Royapettah Hospital, Chennai this study was conducted to evaluate and to analyse functional outcome of total hip replacement.

AIM OF THE STUDY

The aim of the study was to analyse the clinical, radiological and functional outcomes ofuncemented total hip replacement.

HISTORICAL REVIEW

1840 -Carnochan, New York used wooden block between the damaged ends of hip joint

1860 -AugusteStanislasVerneuil, Paris performed the first soft tissue hip interposition

1890 -Gluck introduced an Ivory ball and socket joint fixed to bone with Nickel-plated screws

1919 -Delbet used Rubber femoral head for femoral neck fractures

1925 -Marius N Smith Peterson, Boston introduced the Moldarthroplasty

1936 -Vitallium, an alloy of cobalt-chromium introduced

1938 -Philip Wiles - first Total Hip Arthroplasty with a metal-on-metal prosthesis made of stainless steel

1939 -Frederick R. Thompson of New York – Thompson prosthesis

1952 -Gaenslen introduced metallic acetabular cup

1958 -John Charnley developed Low Friction Arthroplasty (LFA) using Polytetrafluoroethylene (PTFE)

1964 -Ring prosthesis – Acetabular cup with a long threaded stem and a modified Moore's prosthesis as femoral stem

1972 -Pierre Boutin - Femoral component entirely made of ceramic

1980 -Silane used cross-linked HDPE – Wrightington Hospital

1995 -Muller – Cobalt chrome alloy pairings

EVOLUTION OF CEMENTLESS TOTAL HIP REPLACEMENT

Sir John Charnley in 1958 pursued methods of replacing both the femoral head and the acetabulum of the hip joint and he developed a concept of low friction arthroplasty (LFA) after analysing animal joint lubrication. He realized that a cartilage substitute was necessary in order to allow artificial joints to function at extremely lowfriction levels as seen in nature. He first used Teflon shells on the surface of the femoral head and acetabular components. The rapid failure of Teflon parts led to thedevelopment of a new design with a small diameter metallic femoral head attached toacrylic-fixed stem, which articulated with a thick walled Teflon shell. This new design failed quickly due to poor wear characteristics and also led to generation of huge amount of wear debris. These wear debris promoted massive inflammatory reactions in the joints.This led to the development of a socket made of High Molecular Weight Polyethylene (HMWPE) with wear properties was better than

Teflon. Failures of cemented total hip replacement were reported due to many reasons. Toovercome this situation cement less components were developed. Since its launch on the international market in 1985, after having been implanted for thefirst time in 1983 the CLS stem designed by Prof. L. Spotorno hasproven itself as one of the most successful uncemented stem. Thestem is made up of a high strength Ti6 Al TNb forged alloy(PROTASUL-100) and has a rough corundum – blasted finish. Theprosthesis is used with a modular head of Co Cr Mo alloy(PROTOSUL-1) or Al2O3 Ceramic (Biolox) with necks of variouslength.

SURGICAL ANATOMY OF HIP JOINT

Hip joint is a stable ball and socket type of synovial joint with multi axial movements.

ARTICULAR SURFACES

The spherical shaped femoral head articulates with cup like acetabulum of hip bone. Except at the fovea all of the head is covered with hyaline cartilage. The acetabulum has acetabular rim consists of lunate articular surface and acetabular notch. Transverse acetabular ligament bridges the acetabular notch. Fibrocartilagenousacetabularlabrum is attached to the margin of the

acetabulum. Acetabular fossa is the central deep non articular part formed by thinner part of ischium.

Factors increase hip joint stability

1. Depth of the acetabulum is increased by acetabular labrum

2. Tension and strength of ligaments

3. Strength of the surrounding muscles

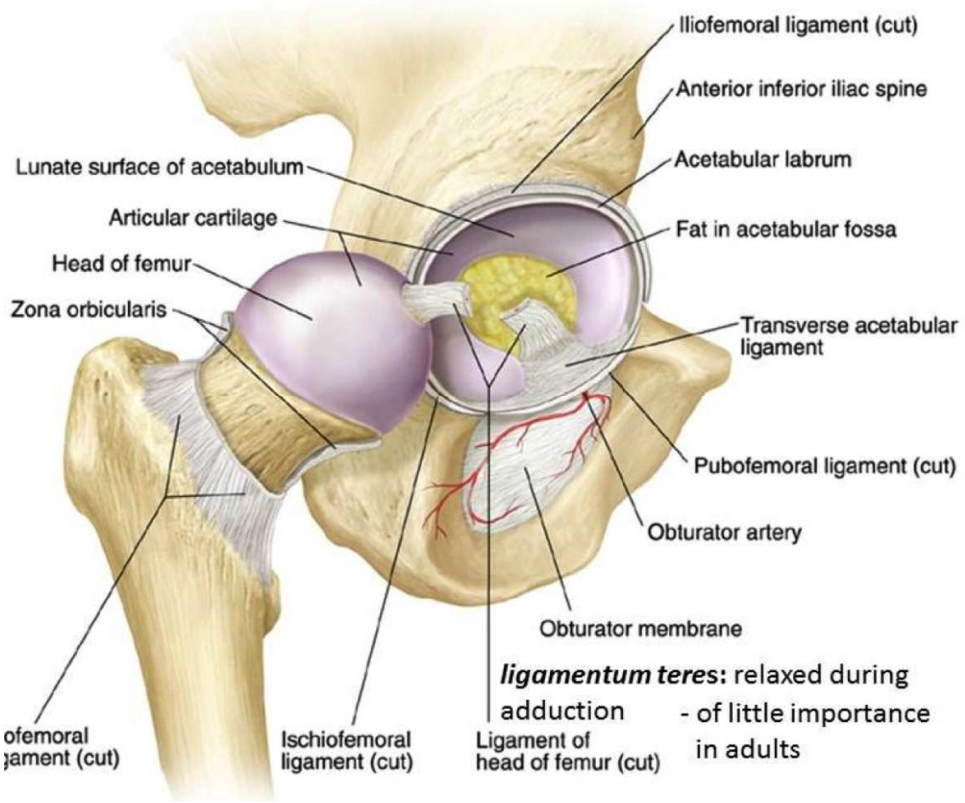
4. Length and obliquity of neck of femur

LIGAMENTS

1. **Joint capsule**

Has outer fibrous layer and inner synovial membrane. In the acetabulum fibrous layer is attached to the acetabular rim and transverse acetabular ligament. In the femur fibrous layer attached is at the intertrochanteric line anteriorly. Fibers of this fibrous layer arranged in two layers the outer longitudinal and inner circular (orbicular zone). Extension of hip joint winds and tightens the fibers of fibrous layer and increases stability of the joint but restricts extension beyond 20^{o}.

Synovial membrane lines the inner part of the fibrous capsule and covers the ligamentumteres. Distal reflection upon neck of femur raises the synovium as ridges called retinacula encloses cervical arteries to femoral head.



2) Ileofemoral ligament (ligament of Bigelow)

Strong Y shaped ligament arises from anterior inferior iliac spine and inserted to intertrochanteric line. It prevents hyperextension of hip joint.

3) Pubofemoral ligament

It arises from obturator crest of pubic bone and merges with fibrous capsule. It gets tightened during extension and abduction and it prevents over abduction of hip.

4) Ischiofemoral ligament

Weak ligament arises from ischium and attached medial to the greater trochanter.

5) Ligamentumteres

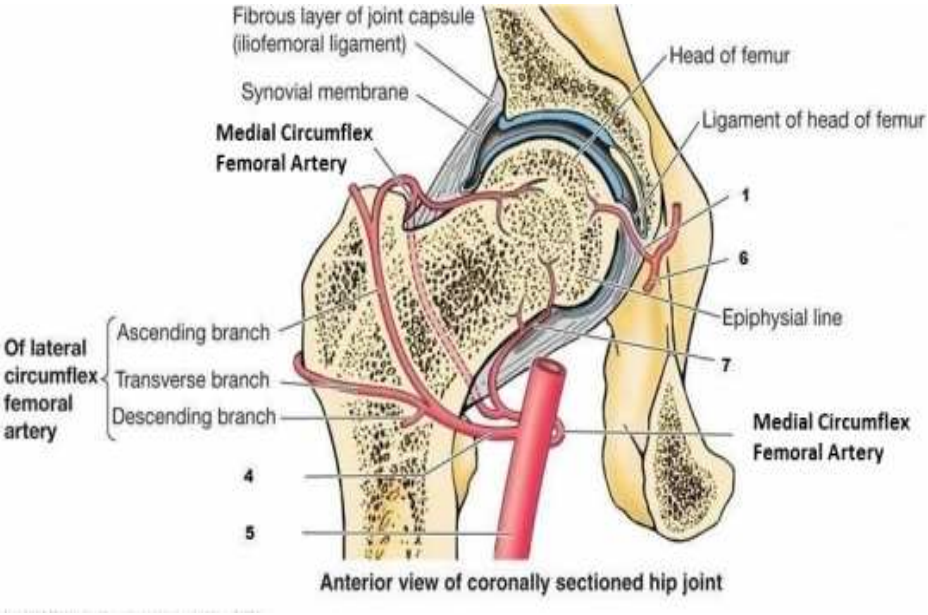
Flat and fan shaped ligament. It narrow end is attached to fovea and wide end attached to acetabular notch. It carries a small artery, which contributes major blood supply to femoral head before epiphysis fusion.

6) Acetabular labrum

It is also called cotyloid ligament. It is a fibrocartilagenous ring which deepens the cavity of acetabulum.

7**) Transverse acetabular ligament**

Bridges the acetabular notch and completes the acetabular rim. Foramen present beneath this ligament traverses vessels and nerves to the hip joint.



BLOOD SUPPLY

Medial and lateral circumflex femoral arteries are primary arterial supply. They form extra capsular arterial ring around the base of the neck. The lateral and medial Ascending cervical arteries derived from this ring pass beneath the synovium and then form sub synovial anastomotic ring at the junction of femoral head and neck. Epiphyseal and Metaphyseal branches arise from this ring and supply respectively. Lateral epiphyseal arteries arise from medial circumflex femoral artery is the predominant arterial supply. In the normal condition the intraosseous pressure of femoral head is about 30mmHg. When pressure is increased more than 30mmhg ischemic changes occur leads to necrosis.

NERVE SUPPLY

The nerves supply the hip joint includes femoral nerve and obturator nerve and the nerve to the quadratusfemoris.

MOVEMENTS

Flexion and Extension - Around transverse Axis

Flexion by iliopsoas

Extension by Gluteal Maximus

Hamstrings

Abduction and Adduction - Around AP axis

Adduction by Adductor longus,

Adductor brevis,

Adductor Magnus

Abduction by Gluteus medius,

Gluteus minimus

Medial and lateral rotation - Around vertical axis

Medial rotation by Tensor fascia lata

Gluteus medius

Gluteus minimus

Lateral rotation by internal obturator

External obturator

Superior gemellus

Inferior gamellus

Quadratusfemoris.

BIOMECHANICS OF HIP

Total hip Replacement biomechanics are not same as of the screws, plates used in fracture fixation. The latter gives only partial support and used in anticipation of the bone union. Total hip prosthesis should withstand cyclical loading as a minimum of 3- 5 times of body weight for many years at times subjected to 10-12 times the body weight[(1) (2)].

Forces acting on the hip

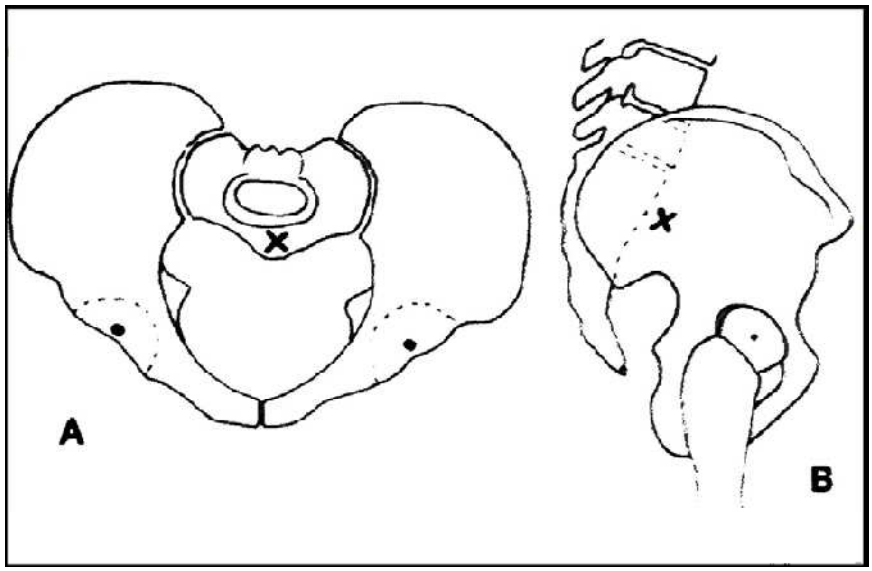
The lever arm of the body weight extends from the center of femoral head to body's center of gravity. Abductor lever arm extends from center of femoral head to lateral tip of greater trochanter and the ratio between this is about 2.5:1. In one legged stance phase, to maintain pelvis level abductor muscles should exert force of about 2.5 times weight of the body. The femoral head is subjected to the estimated load equal to sum of abductor lever arm force and body weight lever arm force which is same during straight leg rising.

Crown in shield et al. [(1)] found forces across the hip joint estimated to 3.5 to 6 times body weight in normal gait and increased up to 10 times when lifting and jumping. These increased forces can cause loosening and bending of the femoral component.

Centralization of head

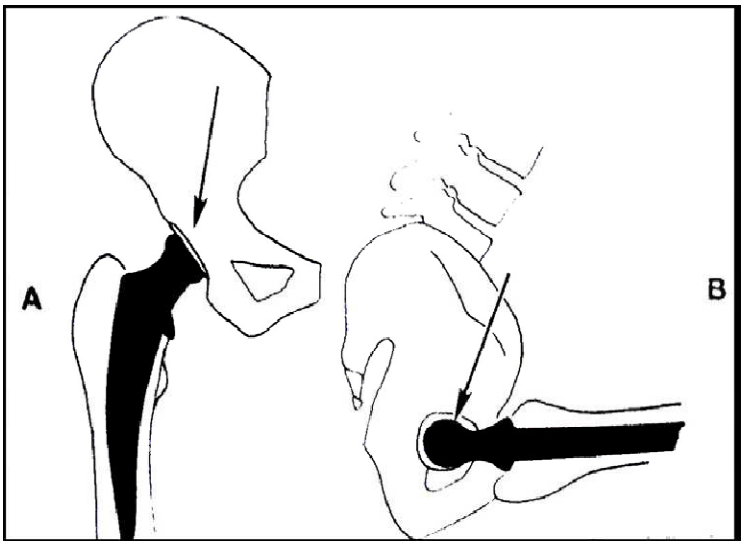
The charnley hypothesis of total hip replacement is to lengthen the abductor lever arm and shorten the body weight lever arm [1] [6] which can be done by deepening the acetabulum and reattaching the ostetomized greater trochanter laterally [1] [6]. In arthritic hip and dysplastic hip the abductor lever arm is shortened due to various reasons like hip dislocation and destructed head. The ratio between the above mentioned two lever arms is about 4:1 in arthritic hip. Reconstruction to make the ratio to approach 1:1 is essential to reduce the load on hip.

The principle of centralization preserves subchondral bone in the acetabulum as much possible and encloses the implant to bone [10] [11].The joint reaction force is reduced when center of rotation is kept in anatomical position. Isolated superior placement produces small increments in forces on the surrounding bone. This principle is used in the treatment of dysplastic hip where superior bone stock is deficient. In spite of this, several clinical studies documented migration of component and higher incidence of radiolucencies are noted in DDH patients and in revision surgery done in patients where center of rotation of hip was placed in nonanatomical position.



AXIS OF HIP JOINT WITH CENTER OF GRAVITY

The body's center of gravity is not exactly on the axis of the hip. The forces acting on both in two planes bend the stem [1] [2]. During normal walking, forces act with the angle of 15^0 to 25^0 anterior to prosthesis. These forces applied in more increased polar angle during stair climbing and lifting and cause the stem to deflect posteriorly or retroverted.

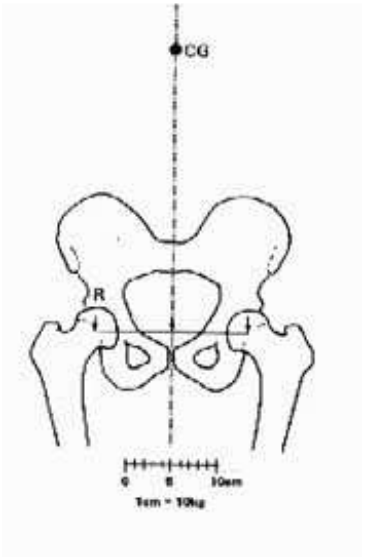


FORCES PRODUCING TORSION OF THE STEM

Rotational Stability

Freeman et al. [1] [4] found that torsional stability can be increased by increasing the width of the femoral stem so that it fills completely in the proximal metaphyseal region. Rotational stability can be increased by various methods include retaining the femoral neck with longer segment and also by using stem with distal tip rounded or rectangular. Extensive porous coating and using stem with longitudinal cutting flukes also improves rotational stability.

APPLIED BIOMECHANICS



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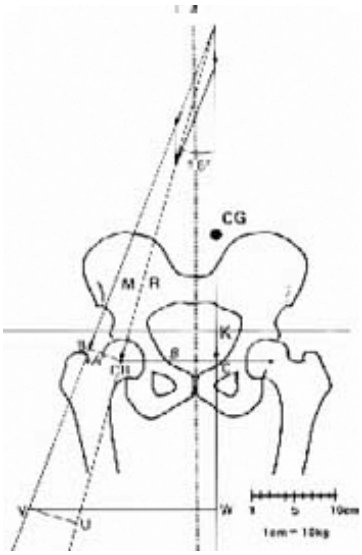

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Fig.1 Fig.2

Bilateral stance Single leg stance

The body weight shared equally on both hips when person stands on both legs (fig .1). The force (R) exerted is equal in both hip joint and is 50% of the total body weight. When person stands on his one leg (Right) his weight of the lifted leg (Left) adds to the body weight. So the centre of gravity shifted to the left at CG as in fig.2.This is marked as vector K in fig.2. Abductor muscles of the standing leg should exert downward pull to keep the pelvis level through vector (M) at the level (B) as in fig.2. Total amount of force on the fulcrum of the hip at the level (O) is the sum of the vectors M and vector K marked as R in fig.2. The amount of force at B and K is directly proportional to the length of the lever arms that is

OB and OC respectively. So the total force at femoral head (O) is sum of M and B that is four times K.

In coxavalga, small abductor lever arm needs more abduction force to maintain the pelvic level such as 7 to 8 times of body weight. The pressure exerted on femoral head is increased. To decrease the pressure and pain patient lists towards the affected hip. This is specific waddling gait of coxavalga. This causes back pain due to secondary strain on lumbar spine. To decrease pressure and pain over femoral head and femoral neck (abductor lever arm) should be adequately maintained particularly in replacement surgeries so that the durability of the prosthesis is increased.

When supporting cane used on the normal side, decreases the body weight (K) and so abductor pull decreased. The cane acts through long lever arm so that slight pressure given through the cane will reduce the pressure on hip. 60% of pressure can be reduced when 10% pressure given through cane.

Waddle hip Biomechanics

When the trunk lists on the affected side, the center of gravity (S5) shifted to affected side as in fig.3. The body weight lever arm (OC) is reduced and abductor pull force required to maintain pelvic level also decreased.

The force exerted on femoral head (R) is slightly higher than body weight[9] [10].

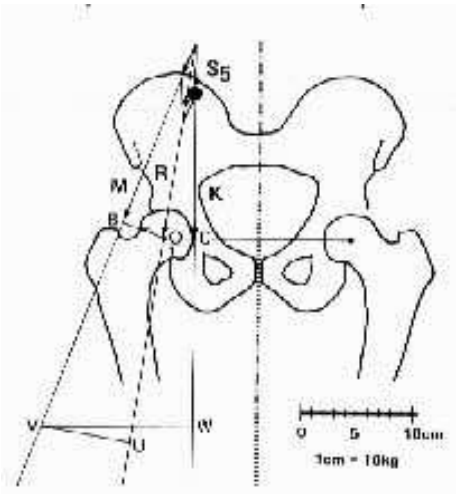


Fig.3

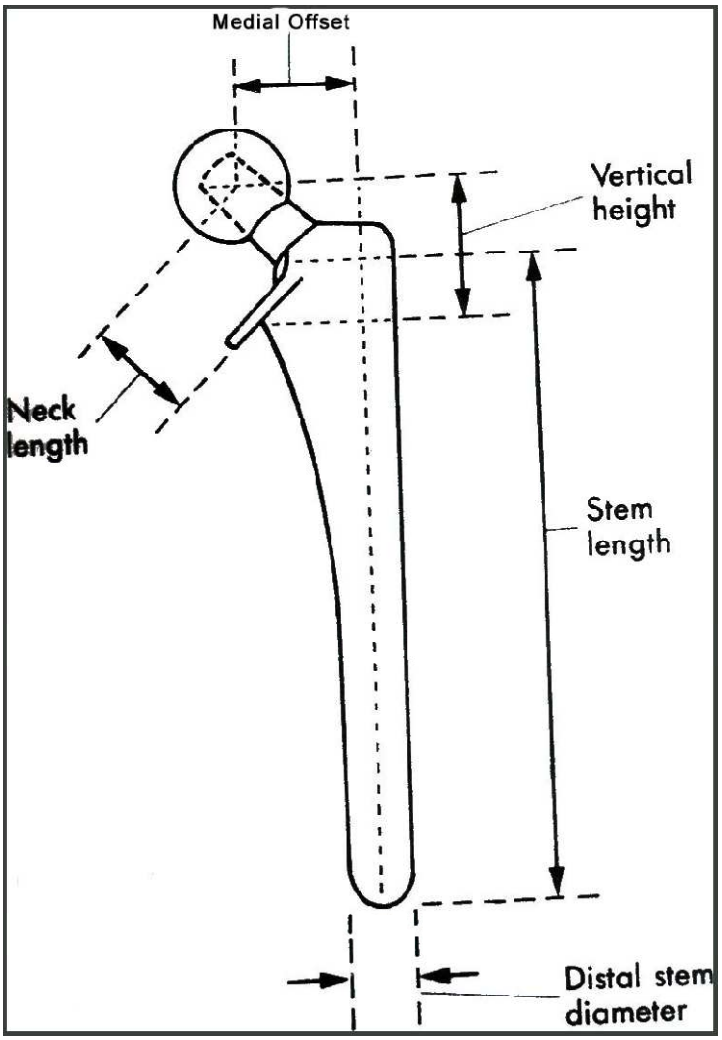
Waddle hip Biomechanics

Neck lengths and offsets

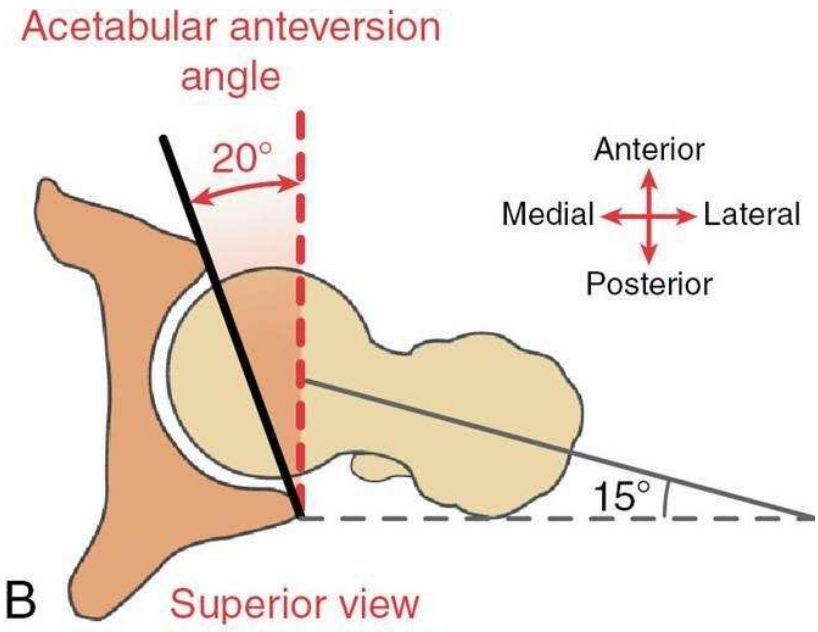
a) Vertical offset - is the distance from a fixed bony point such as lesser trochanter to the center of the femoral head. It is essential to restore this distance to prevent limb length discrepancy. It is determined by length obtained with the modular head plus base length of the prosthetic neck used.

b) Horizontal offset - simply known as offset is the distance between line through the axis of the stem and the center of the femoral head. Inadequate restoration of horizontal offset shortens the abductor lever

arm results in future limp, bone impingement and dislocation. Excessive offset results in future stem loosening and stem breakage. Offset can be increased without limb lengthening by reducing the neck stem angle or by placing the neck in a more medial position.



c) Version - is referred to neck orientation in reference to the coronal plane. It can be denoted as anteversion or retroversion. It is important in achieving stability of the implant.



"Jump distance" refers to the distance the head should travel to come out of the rim of socket which can be increased with use of large diameter head. Increased jump distance results in increased movements of hip[(1)].

BIOMECHANICS RELATED TO IMPLANTS

Basic Requisites of implant materials

1. Biocompatibility of Materials
2. Optimal strength and wear resistance
3. Implants biomechanics similar as that of normal hip

4. Implant materials resistant to environment changes (corrosion resistant)

Tissues response to corrosion of implants can be minimum response of only fibrous tissue formation to maximum response of more thickened avascular tissue barrier formation. Corrosion produces osteolysis and osteoclasis so implants become loose. Chemical Osteomyelitis produces mild sclerosis and new bone formation.

Friction and Wear:-

Contact between bear surfaces occur at particular points which can be seen at microscopic level. Wear and particle production due to corrosion occur at contact area. The different types of wear are:-

1. Adhesive Wear: depends on molecular bonding at the contact area. So wear is reduced if surface finish improved.
2. Abrasive wear: due to rough area at the contact points.
3. Corrosive wear
4. Surface Fatigue

Factors reducing wear:

1. Materials: Alloys which resist corrosion should be used, such as cobalt – chrome and titanium. Titanium should be used along with highly cross

linked polyethylene liner because it has more co efficient of friction. High molecular weight polyethylene has low friction coefficient and high wear resistance. [7] [8]

Degree of cross linking is related to wear resistance of polyethylene. Crown et al [7] [8] in his study found 90% reduction in the polyethylene wear when high molecular weight cross linking used. This can be measured as amount of weight loss in the polyethylene.

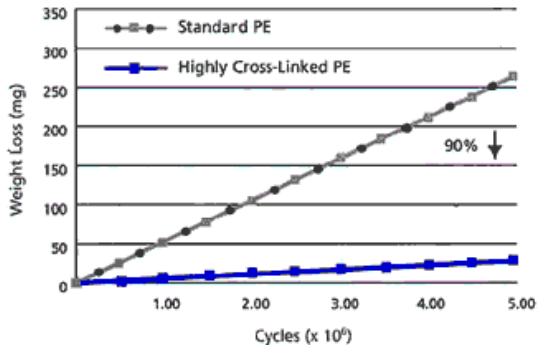


Fig.4. Graphic representation comparing standard and high cross linking. Measures polyethylene weight loss in mg per million cycles

2. Reduction of vertical loads and friction torque: Amount of forces act on femoral head reduced by lateralizing greater trochanter and deepening of acetabulum.

3. Optimal design and made: Spherical design causes close fit and produces more adhesive wear. If contact more towards the polar area frictional torque will be reduced and wear reduced.[1][7] [8]

4. Metal on poly combination: The frictional torque is more on metal on metal combination than metal on poly combination. So wear will be less in metal on poly combination.

COUPLE (FEMORAL HEAD-ACETABULAR LINER)	**VOLUMETRIC WEAR (MM3/YR)**
METAL-UHMWPE	38-56
CERAMIC-UHMWPE	17
METAL-METAL	1
METAL-CROSSLINKED UHMWPE	0.2-5
CERAMIC-CERAMIC	0.04-0.1
CERAMIC-CERAMIC WITH MICROSEPARATION	1.5

Fig.5. Comparison of various alternative bearing surfaces

5. Reduction in the radius of femoral head: Torque Friction (Q) is directly proportional to the head radius: Q = rF.

6. Environment around Implant: P^H of environment is acidic when infection and Haematoma formation. Acidic PH promotes corrosion and wear.

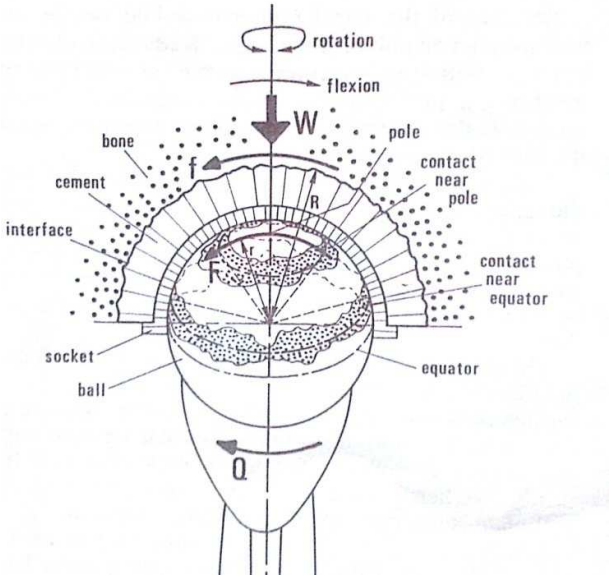


Fig.6. Geometric representation of frictional Torque viewed from medial side at section with acetabulum. Here

Q- Magnitude of torque. r – Radius of head. F- Frictional force. W- Load on the joint. R – Radius of bone implant interface.

Frictional torque is defined as resistance to rotatory motion of femoral head with in the acetabulum. Frictional Torque varies at different axis of motion with maximum during flexion and extension. The magnitude of torque is the product of radius and frictional force which acts tangential to the joint that is Q=rF. If the radius of bone implant interface is R and tangential force is f, then Q= Rf. [8] [9] so f= rF/R that is frictional force is directly proportional to the radius of femoral head. When small diameter of head is used contact occur more in the polar region so less frictional force. When large diameter head used where head fit in the socket and

contact more in the equator and so frictional force will be higher. Frictional torque is less when contact occurs within 45^0 of polar region.

Fate of wear particles:

Debris produced due to metallic wear present in the joint fluid giving the appearance of blackish discoloration. These particles are ingested by phagocytes. But debris due to polyethylene wear is transparent in surrounding tissues which can be seen under polar microscope. These also ingested by phagocytes. Cement particles are extracellular and birefringent, multifaceted. [(7)(8)]On long term effects these particles act like carcinogen in humans is not yet known. But investigation on animals found it produces carcinoma.[(9) (10)]

INDICATIONS AND CONTRAINDICATIONS

INDICATIONS

1) Arthritis

2) Avascular Necrosis

3) Pyogenic arthritis /Osteomyelitis

4) Failed Reconstruction

5) Hereditary Disorders

6) Bone tumors of proximal femur /acetabulum

CONTRAINDICATIONS

Absolute

- Active infection of hip joint
- Unstable medical illness

Relative

- Neuropathic joint disease
- Absent or insufficient abductor mechanism

METHOD OF SELECTION OF IMPLANT

To decide on which stem (cemented or uncemented) to be implanted four parameters are used. Each parameter is given one point. A value obtained for the given patient may be used to select proper implantation. The parameters were:-

1. **Sex**

   Osteoporosis begins around 40 yrs of age in females. Further it is increased during menopause by hormonal changes.

2. **Age**

In patients with less than 60yrs of age an uncemented prosthesis is indicated. Revision surgery if required it will allow easy removal of the implants. In patients with 70 yrs of age or more than that cemented prosthesis is used.

3. Singh's index

This classification system measures the degree of Osteoporosis depends on changes in the trabecular pattern in proximal end of femur

Stage 6 - (normal) all trabeculae present

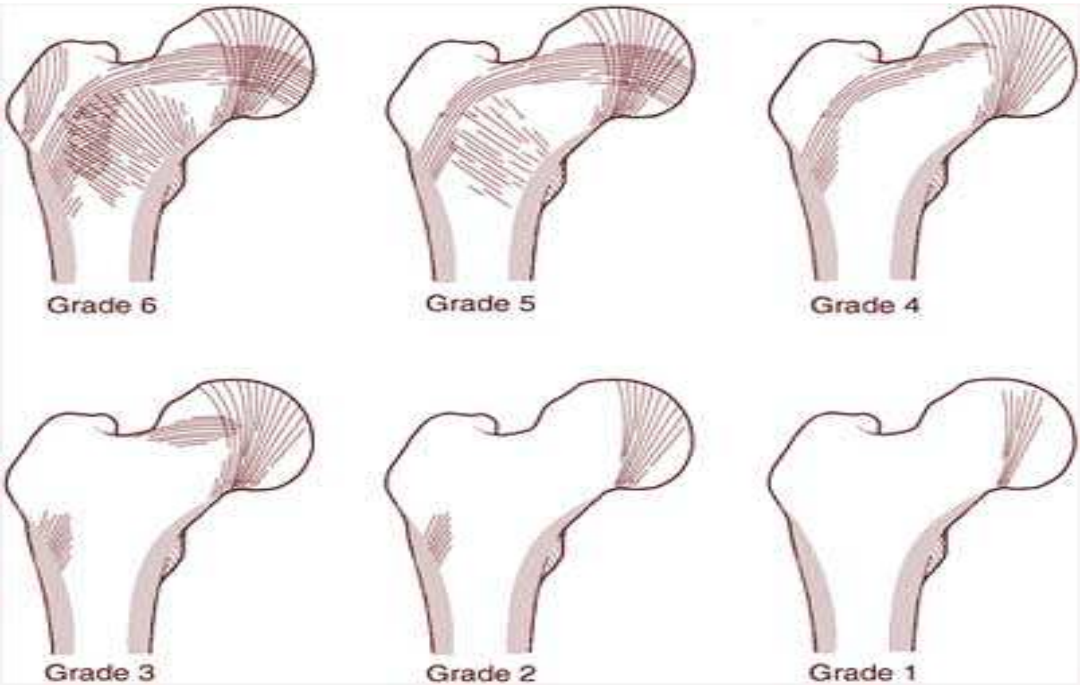
Stage5 - loss of trochanteric and secondary tensile group

Stage4- loss of secondary compressive trabeculae

Stage3- definite osteopenia break in primary tensile group

Stage2- complete loss of primary tensile group

Stage1-only primary compressive trabeculae seen but attenuated



4. Morphological cortical index

Three types of shapes of femur can be seen on radiographs. These are trumpet, cylindrical and dysplastic. Of which trumpet shape suitable for cementless fixation.

Morphological index is the ratio of the distance between two outer cortical surfaces at the level of lesser trochanter(AB) to the distance between the inner cortical surfaces at the level of isthmus(CD).

MCI = AB/CD

Evaluation of patients

Gender		Age		Singh's index		MCI	
	Score		Score		Score		Score
MALE	0	<50	0	6	0	>3	0
FEMALE	1	<51-60	1	5	1	3-2.7	1
		<61-70	2	4-3	2	2.6- 2.3	2
		>70	4	2-1	4	<2.3	4

Total score	plan
0-4	Uncemented
5	Possible
≥ 6	Cemented

FIXATION OF CEMENTLESS IMPLANTS

Biological fixation is paramount for the success and durability of uncemented total hip replacement. Immediate primary fixation should be stable so that secondary bone growth can occur. Formation of woven bone surrounding the implant without cartilaginous intermediary occurs first followed by lamellar bone remodeling that contributes to bone growth.

Based on radiographic findings engh and bobyn provided radiological classification of implant fixation.[1] [2]

1. Fixation by bone in growth is established as when no subsidence and no or minimal radio opaque line around the implant. Hypertrophy of cortex at the distal end of the stem and “spot welds” between stem and periosteum may present. Proximal stress shielding of varying degree may present.

2. Fixation by fibrous growth is defined as extensive radiopaque lines around the stem and without migration of the implants. The radio opaque lines lying in parallel fashion around the stem. These lines separated from the stem with 1mm wide radiolucent areas. No local cortical hypertrophy of femur suggested uniform load transfer function.

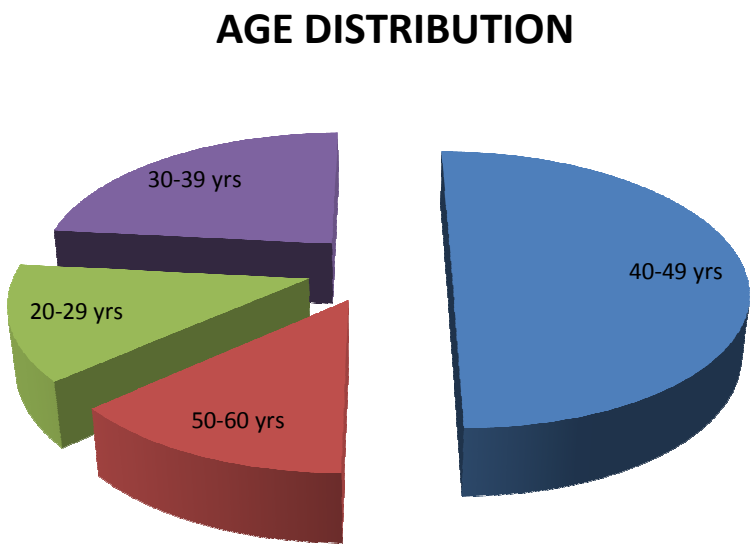
3. Unstable implant is said when there is presence of either migration of the stem or subsidence present and also there is widely separated divergent radio opaque lines surrounding the stem present. Localized cortical hypertrophy around the distal end of the stem and collar present indicating lack of uniform load transfer.

MATERIALS AND METHODS

In our institution 30 cases of uncemented total hip arthroplasty were done for various indications. Follow up period ranges from 1year to three years.

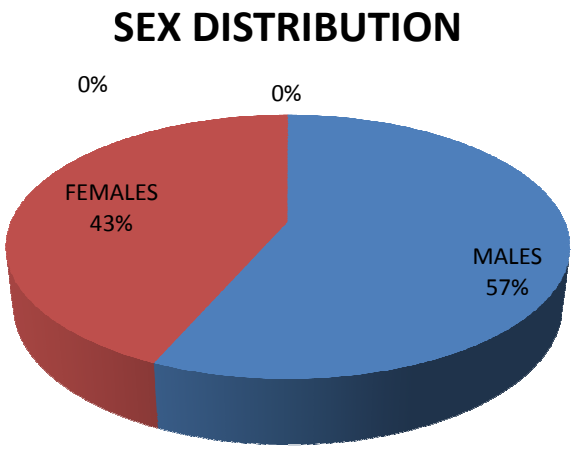
AGE DISTRIBUTION IN OUR STUDY

S.No	Age group	No.cases	% cases
1.	20- 29	4	13.3%
2.	30-39	7	23.3%
4.	40-49	15	50%
5.	50-60	4	13.3%



SEX DISTRIBUTION IN OUR STUDY

S.No	Gender	No. of cases	% of cases
1.	Male	17	56.3%
2.	Female	13	43.3%



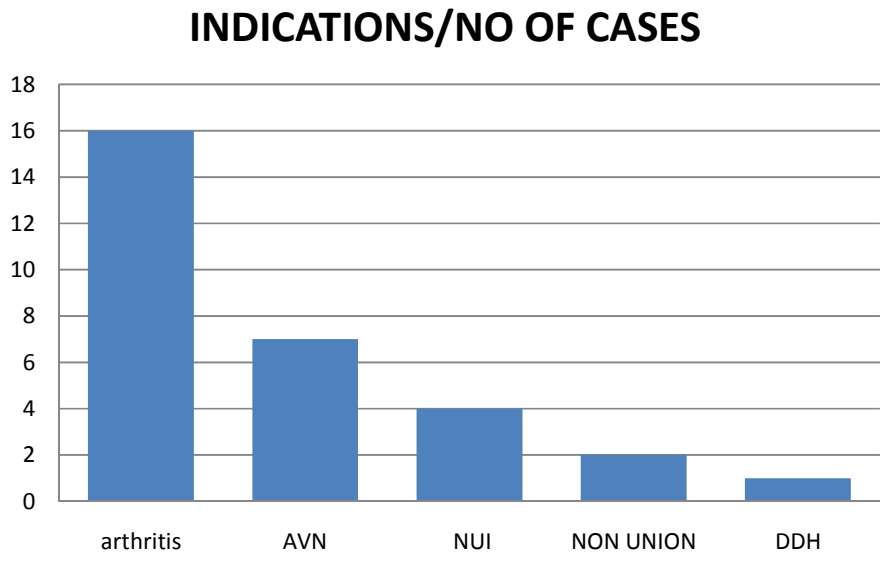
SIDE DISTRIBUTION

S. No	side	No. of cases	% of cases
1.	Right	16	53.3%
2.	Left	14	36.6%

VARIOUS INDICATIONS

S.No	DIAGNOSIS	No. cases	% of cases
1.	Chronic Arthritis	16	53.3
2.	AVN of head of femur	7	23.3
3.	Fracture Neck of femur with implant failure	4	13.3
4.	Fracture neck of femur	2	6.6
5.	Dysplastic Hip	1	3.3

Most common indication is chronic arthritis.



DATA COLLECTION METHODS

Collection of the data as per the proforma with consent from the patients admitted in the Orthopaedic department, Govt. Royapettah Hospital, Kilpauk Medical College, Chennai.

INCLUSION CRITERIA

- Patients in the age group < 60 years
- Patients with hip pain and Arthritic Changes in the Radiographs

EXCLUSION CRITERIA

- Active Infection of the Hip joint
- Unstable Medical Illness
- Neuropathic Joint

METHODS

PREOPERATIVE EVALUATION OF THE PATIENTS AND RADIOGRAPHS

All patients were assessed with the following protocols.

- Medical condition of the patient is assessed for DM, HT, Anemia, cardiac diseases, thromboembolism.
- Aspirin and other anticoagulants are stopped 1 week before surgery.
- Skin lesions like pyogenic infection should be eradicated.
- Purulent discharge of hip joint should be investigated for culture and sensitivity.
- Transurethral resection of prostate to be done for urethral obstruction before elective procedure.
- Soft tissue of hip to be investigated for scarring and inflammation.
- Abductors strength is evaluated before surgical procedure.
- Any fixed deformity and limb length discrepancy is assessed.
- In case of ipsilateral involvement of hip and knee arthritic hip should be operated first.
- Hip pain can be referred to anterior thigh and knee.

- Hip joint status should be assessed pre operatively by Harris hip score.
- About 1000- 1500 ml of blood loss is expected during perioperative period of total hip arthroplasty.
- To reduce transfusion related reaction and infection banking of autologous blood prior to surgery to be done.
- Transfusion of 4to 5 units of blood for revision surgery and 3units of blood for primary procedure is required.
- In bilateral involvement the most painful hip is operated first 3months after the other hip should be operated.

PREOPERATIVE ASSESSMENT OF RADIOGRAPHS

- Anteroposterior view of pelvis with proximal femur and hip lateral view with proximal femur are required. X ray knee and spine is needed in special cases.
- Radiographs are reviewed to check the adequacy of bone stock for the acetabular component fixation, the need for bone graft and amount of reaming required and to check whether osteophytes present or protrusion can make the dislocation difficult.
- When old previous fractures occurred special views are taken to check any defect in acetabular wall.

- The diameter of medullary canal is measured as in DDH and dwarfs it may be small in diameter. In these situations femoral stem with small diameter and short length is required.
- Presence of Anterior bowing in situations like Paget's disease and old fracture shaft of femur make the medullary canal reaming difficult. In these cases femoral osteotomy is indicated.

DESCRIPTION OF IMPLANT

Femoral Component

In all cases "Taper Loc" hip system used. Primary type 1 taper loc stem has the advantages of excellent rotational stability and smooth load transfer to the femur and with the lateral offset design that allows stability without lengthening of leg. Taper loc stem is made with high strength titanium alloy. Plasma spray porous coating with titanium alloy powder generates a random distribution of pore size between 100 to 1000 microns providing a large contact area between substrate and particles. The stem is used with a modular head made with cobalt chrome alloy.

A flat wedge shaped design used in the typical ovoid femoral canal provides better rotational stability. Sharkey et al. found in his study taper loc stem to have excellent stability. The tapered titanium geometry in the taper loc stem design, allows for a gradual transition in stiffness from the upper end of femur to the middle of femur. The use of collarless stem design in the taper lochip tends to allow for the self-seating of the implant and achievement of optimal rotational stability.

ACETABULAR COMPONENT

‘Ring loc’ acetabular component was used in all cases. The ring locacetabular component redefines the standard acetabular technology. The components provide an unparalleled liner locking mechanism, maximum polyethylene thickness and congruity. The taper loc system is compatible with all ring locacetabular components. Fixation achieved by forcing the implant into the under reamed acetabulum.

The components of this are:-

Titanium shell

It consists of hemispherical acetabular shell and polyethylene liner.

Screw sockets

Openings for cancellous bone screws present in proximal half of the shell. Three dome holes present in the 11 clock 3clock and 1 clock.

Pyramids

On the edge of shell sharp pyramid like elevation is present which are impacted into cancellous bone on insertion.

Polyethylene liner

We used 10o polyethylene liner which shifts the center of rotation anatomically 3.2mm to 5.8 mm as liner gets larger. It

restores the center of rotation of acetabular components which are vertically placed.

SURGICAL PROCEDURE

Preoperative Templating

Femoral stem and acetabular cup size is measured by template.Templating was done before surgical procedure to know the approximate neck length, offset and version. The following procedure of templating was used.

- AP view pelvis and lateral view of affected hip was taken in proper position and 15 degrees internal rotation. The amount of magnification is estimated correctly.
- Amount of limb shortening was measured by drawing a line parallel to the level of ischial tuberosity that intersects the lesser trochanter on each side.
- To measure acetabular cup size the template with its medial position was placed at the level of tear drop and its inferior tip at the level of obturator foramen. The center of acetabular component was noted, it is the new center of rotation of hip.
- Femoral component size was selected that matches with proximal canal. To restore limb length appropriate neck length was selected.

SURGICAL PROCEDURE

Spinal anaesthesia with epidural anaesthesia is given in all cases.A third generation intravenous antibiotics like ceftriaxone 1gm administered in the operative room ½hr before surgery. Peak serum concentration is obtained 20 min after administration. The infection rate decreased from 11% to 1%.

Surgical approach

Hardinge direct lateral approach is used in all except 3cases in which Moore's posterior approach is used. Charnley used anterolateral approach with greater trochanteric osteotomy. Nowadays this approach used less commonly because of problem related to nonunion of greater trochanter. Surgeon preferred over the choice of approach.

Hardinge lateral approach

Patient in lateral position bony landmarks are marked, a lazy J shaped incision centered over greater trochanter made. Fascia lata incised in line with skin incision and retracted anteriorly and gluteus maximus retracted posteriorly to expose the gluteal medius insertion and vastuslateralis origin.

Gluteus medius tendon incised at post 2/3 and ant 1/3 junction of muscle. Incision extended distally along the vastuslateralis and down to the bone. To avoid injury to superior gluteal nerve

dissection not to be extended 5cm proximally in gluteus medius. Gluteus medius retracted to expose the gluteus minimus.

Insertion of gluteal medius and vastuslateralis are elevated and hip abduction exposes the anterior capsule to be incised. Gluteus medius and minimus splitting allow dislocation of hip anteriorly and provide good exposure of acetabulum.

The dall variation of this approach is elevation of thin plate of bone along with anterior portion of abductor muscles from the anterior edge of greater trochanter so that repair can be done easily.

TECHNIQUES OF TOTAL HIP REPLACEMENT

Preparation of acetabulum

Femoral head is dislocated with the above one of the mentioned approach. After femoral head dislocation appropriate amount of neck resection done. Amount of neck resection depends on type of the prosthesis implanted.

Insertion of acetabular cup:

1. Patient in true lateral position is checked again.
2. Acetabulum is exposed by rotating the femur internally or externally so that proximal femur part will lie posterior to the acetabulum. Superior and inferior lip of acetabulum is seen well only after removing the acetabular labrum from its attachment.

3. Progressive reaming is done while maintaining the congruency of acetabular surface. A component selected is 1 to 2mm more than the last reamer size used to give more stability.

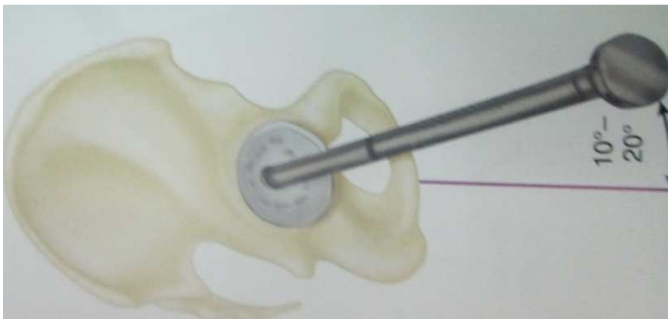


Fig.1.Anteversion

4. Arranging the acetabular component with the positioning device. To decide correct angle of inclination a bar extending from the positioning device oriented parallel or vertical to the floor is used. One more extension bar determines the degree of anteversion. The correct angle of inclination is 40 to 45 degrees. The correct anteversion is 20 degrees.(Fig.1,2)

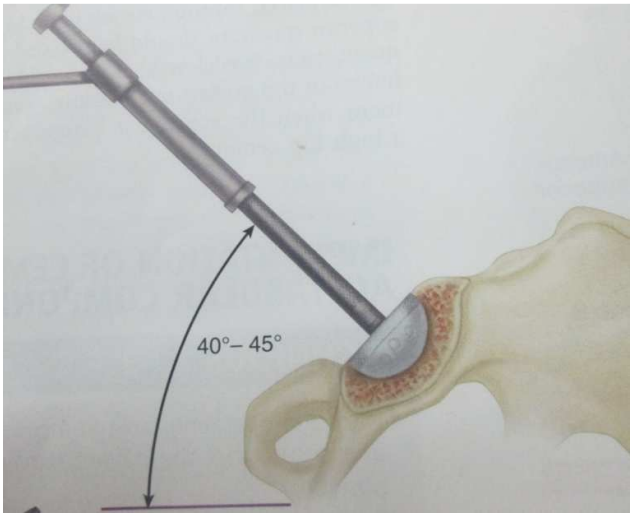


Fig.2.angle of inclination

5. Positioning device is maintained in alignment until the impaction completed. Once the subchondral bone reached a change in sound is heard. After that the positioning device is removed if position is satisfactory. If gap is still present further tapping done till the gap close.

6. Fixation of augmentation screws in the posterosuperior region is ideal. Drill hole should be made in center of hole. Improper placement of screw resulting in lifting of acetabular cup and difficulty in positioning the liner can happen. Sciatic nerve can be prevented by placing finger in the sciatic notch. Stability of the cup should be checked. Excess osteophytes and debris should be removed.

7. Soft tissue interposition should be cleared off from the cup before inserting polyethylene liner. Center of offset should be placed in superior or posterosuperior region.

Insertion of cementless femoral stem

1. After exposing the femur entry reaming done at a point posterior and lateral to pyriformis fossa. Lateralization is done by forward the reamer initially towards the greater trochanter then aiming down towards the medial femoral condyle. Reaming proceeded till the diaphysis felt. (fig.3)

 Fig.3. Femur Broaching

2. Femoral broaching done till size of less than 2 of the measured stem size. Initially broaching done towards laterally to avoid medialisation of the stem. Version aligned and maintained while broaching. Progressive broaching with larger diameter should be done. If progression is difficult lateralization should be checked again. Fit of the broach assessed for contact with cortical surfaces. Stability of fixation assessed by rotating the broach and observed for any motion. If motion is seen broaching proceeded with larger size.

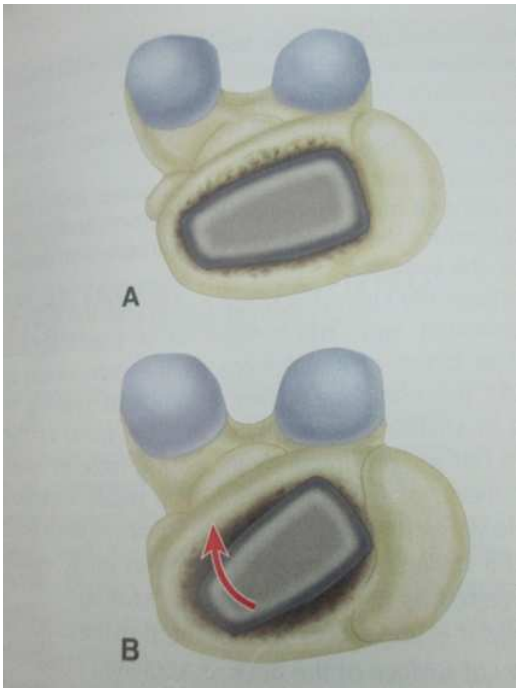


Fig.4 Femoral anteversion and rotational stability

3. If stability is adequate final neck preparation to be done. Neck resection pre operatively assessed at what level from the lesser trochanter. If needed necessary neck resection can be done at this stage. Trial neck inserted and center of femoral head and tip of trochanter distance assessed.

4. If neck length is adequate thorough debris removal done and hip reduced. If reduction is difficult reassess the offset and neck size and polyethylene liner.

5. Impingement of neck and stability of joint are checked. Hip joint should be stable in extension and flexion and adduction. Suck test to be done if it is positive use longer size neck. If limb length

appears to be increased use stem with more offset so that stable hip acceptable limb lengthening can be achieved.

6. Trial components are exchanged with implants if acceptable reduction and range of motion with stability achieved. If intra operative femur fracture occurs the stem should be removed first and exposed till full extension of the fracture visible. Cerclage wire applied at appropriate level and stem reinserted. Tension in wire applied is checked. Stability of hip joint is checked.

POSTOPERATIVE PROTOCOL

Antibiotics are given for 12 days till suture removal. Drain removed on 2nd post op day. A triangular pillow is used to maintain the hip in 150abduction so that dislocation can be prevented in the immediate postoperative period. Pre operatively patient is advised about dos and don’ts like to avoid strenuous activity and not to sit on floor with cross legged and not to squat and to maintain ideal body weight.

During the 1st postoperative day limited mobilization and bed exercises begin. Quadriceps and gluteal isometrics and deep breathing exercises begin. Straight leg rising is not beneficial in total hip arthroplasty.

On the 2nd postoperative day patient can sit on the chair in semi recumbent position.

During 1st postoperative period or after drain removal gait training started using a walker for balance and stability. Amount of weight bearing allowed depends on presence of stress risers in femur and bone grafts used and method of fixation of components and trochanteric osteotomy. Limited weight bearing for 6 to 12 weeks is recommended in cases of cement less fixation.

Patient is encouraged to walk on the 3rd postoperative day with crutches. Limited weight bearing should not exceed more than 1/3 of body weight. Patient can be discharged under normal conditions during 10th to 12th postoperative day after suture removal. Follow up examination is done at 7 weeks after surgery and advised gradual increase in weight bearing for the subsequent 7 weeks. Hip extension exercises are advised if preoperative flexion deformity co exists. Patient is advised to use western type toilet for toilet purposes. Sexual activity may be resumed.

During 3 to 6 months of postoperative period nearly half of muscle strength is regained. After 3 months patient can return to work avoiding strenuous activity.

FOLLOW UP PERIOD PROTCOL

A standard protocol was used in the postoperative period. Follow up visits are made at 1 month, 3months, 6 months, 1 year and periodically thereafter. Routine plain radiographs were taken and assessed for loosening, migration, osteolysis during follow up visits.

Postoperative Radiological Assessment

Femoral Component

1. By using Moss Template Center of Rotation of hip compared is to normal side.
2. Fixation of femoral component is assessed by presence of optimal contact of stem with both lateral and medial endosteal cortical surfaces for about 5cm.
3. Tip of the stem positioned in Neutral without any varus valgus angulation.
4. Level of the Greater Trochanter tip which corresponds to the center of femoral Head
5. Level of the both sides lesser trochanter for any limb length discrepancies.
6. Seating of collar of the stem correctly over the calcarfemorale.

7. Restoration of both vertical and medial offset compared to normal side.

8. Orientation of Neck to the vertical offset. In valgus hip the medial offset is smaller than vertical offset so the center of head lies superior to the level of trochanter tip. In varus hip medial offset larger than vertical offset so the center of head lies inferior to level of trochanter tip.

Fig.5 femoral loosening zones as described by Gruen

9. Gruen et al Zonal analysis for loosening

The Femoral stem is separated into 7 zones, Each zone is analyzed for radiolucency and radiopaque lines and for bony apposition

10. Bending of stem is assessed by angle made between a line drawn along the lateral surface of distal stem and another line drawn through the center of neck and head.

11. EBRA- FCA Method for measuring the migration of stem.

Einzel –Bild–Roentgen-Analyse method is used to assess the femoral component migration. Compared with Roentgen stereo photogrammetric analysis this method has the specificity of 100%. This is accurate method to assess stability with in particular period. Migration of prosthetic implants early is predicted to later failure. This method gives information regarding about subsidence and the lateral and medial distance between prosthetic margin and bone margin.

There are four Different reference lines to describe the migration.

a - Tip of greater trochanter to stem shoulder

b - Tip of greater trochanter to center of head

c - Tip of lesser trochanter to shoulder head

d - Tip of lesser trochanter to center of head

Acetabular component

Assessed by following parameters:-

1. Optimal size and correct seating of cup without polar gap

2. Correct inclination of the cup to the tear drop level. Excessive inclination > 450 results in dislocation of prosthesis on

adducting the limb. Horizontal inclination results in posterior dislocation and early impingement on flexion.

3. Degree of anteversion – normal anteversion of acetabulum is about 150 to 200. The version is determined by position of the anterior and posterior half of circumferential wires in the cup.

4. Polyethylene wear- is measured by the distance of migration of femoral head into polyethylene. It is assessed by superolateral penetration of femoral head of more than 2.5mm.

5. The position of transacetabular screws

The acetabulum is divided into four quadrants by two lines which are antero superior, antero inferior, postero superior, postero inferior. Screws placed in the anterosuperior quadrant may injure the external iliac arteries and vein. Screws placed in the anteroinferior quadrant may injure the obturator vessels and nerves. Screws placed in the postero superior and postero inferior quadrant may not emerge within the pelvis. But it may pass through the sciatic notch and injure the sciatic nerve and superior gluteal vessels. However the screw threads and drill bit can be felt and palpated in the sciatic notch, so that injury to sciatic nerve can be avoided. The anterosuperior quadrant can be avoided and postero superior quadrant is safest zone for using transacetabular screws.

6. The acetabular component loosening is described by DeLee and Charnley.

Loosening is measured in three zones of acetabulum.

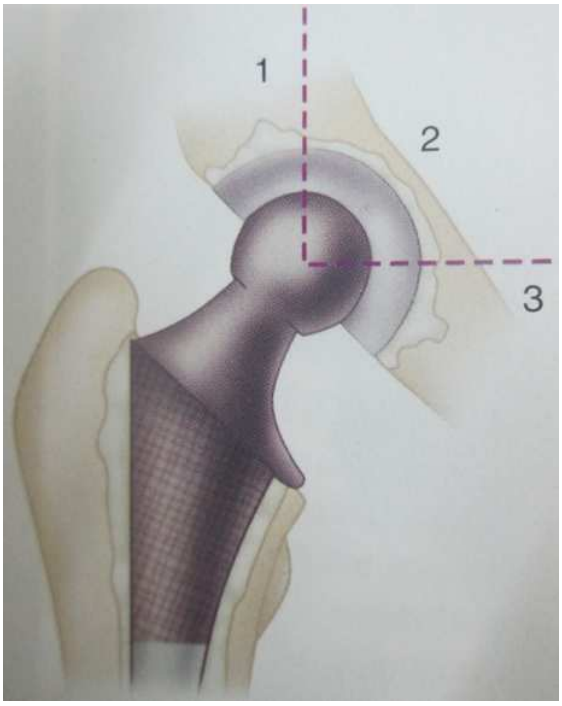


Fig.6 loosening zones as described by DeLee and charnley

7. Reinforcement of acetabulum with rings, cages, and impaction grafting are noted.

8. Protrusion of cup- The Radio graphic hall mark of protrusion of hip is the migration of the cup medially beyond the ilio- ischial line (kholer's line).

Radiologically patients were classified into

Group I - No evidence of loosening (migration, Osteolysis)

Group II - Evidence of loosening present on radiographs but the patient is asymptomatic.

Group III - Evidence of loosening in a symptomatic patient

Functional outcome assessment

Assessment is done by using modified Harris Hip Score. Harris Hip score has the following components:-

1. Pain – (44 Points Maximum)
2. Gait (walking maximum distance) (33 points Maximum)
3. Functional activity(14 points Maximum)
4. Absence of Deformity (4 points Maximum)
5. Range of motion (5 points Maximum)
6. Total – 100 points.

The Harris Hip Score is Graded as follows:-

Score	Grade
<70	poor
70-79	Fair
80-89	good
>90	Excellent

ANALYSIS AND RESULTS

In our study majority of patients (53.3%) had chronic arthritis of hip and 23.3% of patients had avascular necrosis of femoral head.

13.3% of patients were treated with cancellous screws fixation for fracture neck of femur, subsequently patient developed avascular necrosis of femoral head which are treated by uncemented total hip replacement.

6.6% of patients had fracture nonunion neck of femur.

3.3% of cases had developmental dysplasia of hip with secondary arthritis.

All patients had severe pain with limitation of daily activities of living. Preoperative assessment with Harris hip score was done in all cases.

The surgical approach used depends on the preference of the operating surgeon. Hardinge's direct lateral approach was used in 73.3% cases and Moore's posterior approach used in 26.6% cases.

"Ring Loc" standard cup with highly cross linked polyethylene liner was used in all cases. "Taper Loc" porous coated femoral stem was used in all cases. Follow up period ranges from 1 to 3 yrs.

All patients were radiologically assessed for the following parameters.

Femoral Component

- Prosthesis level above the lesser trochanter averages about 1.5 cm
- Optimal position of the prosthesis

  Neutral - 76.6%

  Varus - 13.3%

  Valgus - 10%
- Canal fill of the stem in anteroposterior diameter averages about 80%.
- Intra operative femoral fracture is seen in two cases which were treated by cerclage.
- Aseptic loosening of femoral stem in Gruen zones 3, 4,5 is seen in one case.
- Majority of the stem had shown good osteointegeration.
- There was no evidence of calcarresorption indicating no subsidence in any of the case.
- There is no evidence of osteolysis around femoral stem as indicated by radiopaque line formation in any of the case.
- Heterotopic ossification was noted in one case around the trochanteric region without any limitation of range of motion.

Acetabular component

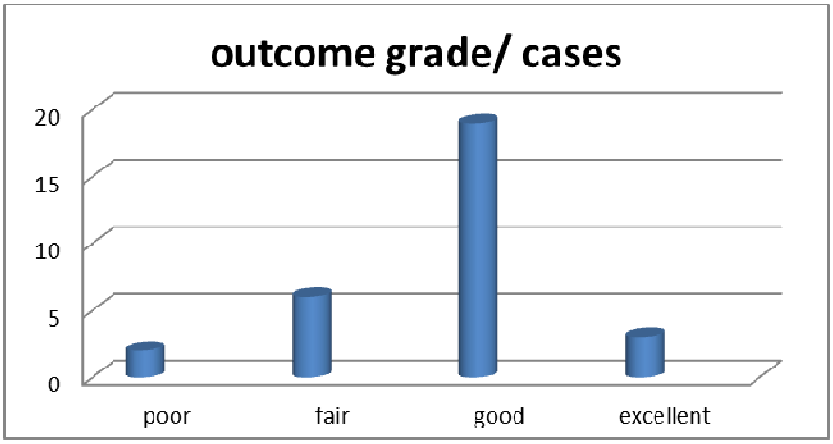
- Correct positioning with 45 degrees inclination and 15 degrees anteversion is seen in 83.3% cases.
- Acetabular component with overhanging margins beyond the superolateral rim is seen in 2 cases.
- Correct seating without any polar gaps and intimate contact with subchondral bone is seen in 93.3% cases.
- Transacetabular screws to secure the cup firmly to the acetabulum used in all cases.
- Acetabular loosening in Charnley and DeLee zone2 is seen in one case.
- Pelvic Osteolysis is seen in one case.
- No protrusion of the cup into the acetabulum was encountered in our study.
- In a case of dysplastic hip acetabular reconstruction was done using autologous iliac crest bone graft. In the subsequent follow up period the graft was found to be incorporated completely.
- Postoperative sciatic nerve palsy was encountered in dysplastic hip case.
- Deep vein thrombosis is seen in two cases. It was treated with antithrombolytic agents.

Preoperative hip score in our study is as follows

30- 39	3 cases
40- 49	23 cases
50- 60	4 cases

Postoperative Harris Hip score as follows

90-100	excellent	3 cases(10%)
80-89	good	19 cases (63.3%)
70-79	fair	6 cases (20%)
<70	poor	2 cases (6.3%)



The poor results are seen in 2 cases. In one case poor result is due to postoperative dislocation. This patient had suffered from severe arthritis of hip. In another case poor result is due to noncompliance to follow up postoperative instructions and mobilization.

The fair to poor results are due to

- Severe arthritis with restriction of daily activities of living.
- Intraoperative femoral fracture in 2 cases.
- Deep vein thrombosis in 2 cases.
- Postoperative sciatic nerve palsy in one case.
- Pelvic osteolysis in one case.
- Persistent anterior thigh pain in 2 cases.
- Limb length discrepancy with shortening of 1cm in one case and lengthening of 2cm in 3cases was seen.

RESULTS

- Uncemented total hip arthroplasty has a definitive role in the treatment of chronic arthritis in young patients.
- In our study most of the patients belongs to the age group of 40- 50 yrs (53.3%).
- Males (56.6%) predominate in our study.
- Chronic arthritis is the most common indication in our study.
- Uncemented total hip arthroplast was done in all cases. In bilateral affected cases severely operated limb was operated.
- Ring locacetabular cup and Taper loc porous coated femoral stem is used in all cases.
- 76.6% cases had femoral stem in neutral position with osteo integration.
- Optimal cup size with 45 degrees inclination at the tear drop level is seen in 83.3% cases.
- 63.3% cases had good functional outcome with Harris hip score of 80- 89%.

Incidence of various complications

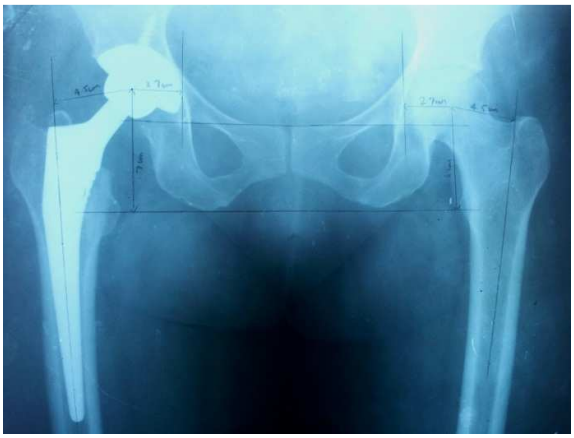
- Postoperative dislocation in one case (3.3%)
- Intraoperative femoral fracture in two cases (6.6%).
- Postoperative sciatic nerve palsy in one case (3.3%).
- Postoperative deep vein thrombosis in two cases (6.6%).
- Femoral stem aseptic loosening in one case (3.3%).
- Acetabular cup loosening in one case (3.3%).
- Pelvic osteolysis in one case (3.3%).
- Limb length discrepancy in 4 cases (13.3%).
- Anterior thigh pain in 2 cases (6.6%).
- Heterotopic ossification in one case (3.3%).

CASE 1- EXCELLENT FUNCTIONAL OUTCOME

DIAGNOSIS- CHRONIC ARTHRITIS RT HIP

PRE OP XRAY

POST OP XRAY



CASE 1 –CLINICAL PICTURE

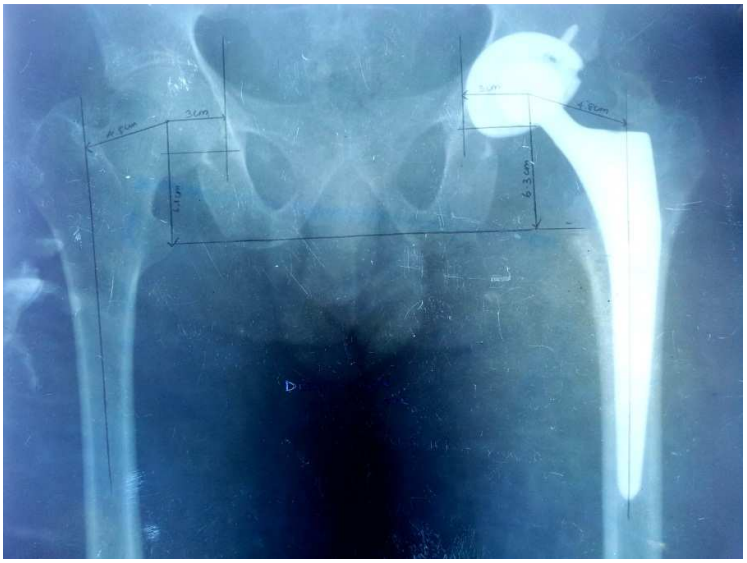




CASE II -

PREOPERATIVE PICTURE

POST OP XRAY



CASE II – CLINICAL PICTURE

CASE 3-CHRONIC ARTHRITIS RT HIP

PRE OP XRAY

POST OP XRAY

CASE 4 DYSPLASTIC HIP WITH ARTHRITIS

PRE OP XRAY

POST OP FOLLOW UP XRAY AT 18 MONTHS

ACETABULUM IS RECONSTRUCTED WITH ILIAC CREST GRAFTING. INCORPORATION OF GRFT IS SEEN.

COMPLICATIONS

POST OPERATIVE DISLOCATION

PRE REDUCTION XRAY

POST REDUCTION XRAY

COMPLICATIONS

1. INTRA OP FEMORAL FRACTURE TREATED

2. HETEROTOPIC OSSIFICATION

DISCUSSION

This prospective study was conducted to analyse the radiological, clinical and functional outcome of uncemented total hip replacement for various indications.

The results of the study are compared with the known similar studies reported in literature.

TABLE 1

THE MEAN AGE GROUP

Schramm et al[23].	47 years
Peter Aldinger et al[24]	51 years
Siebold et al[26]	55 years
Alexander et al[66]	54 years

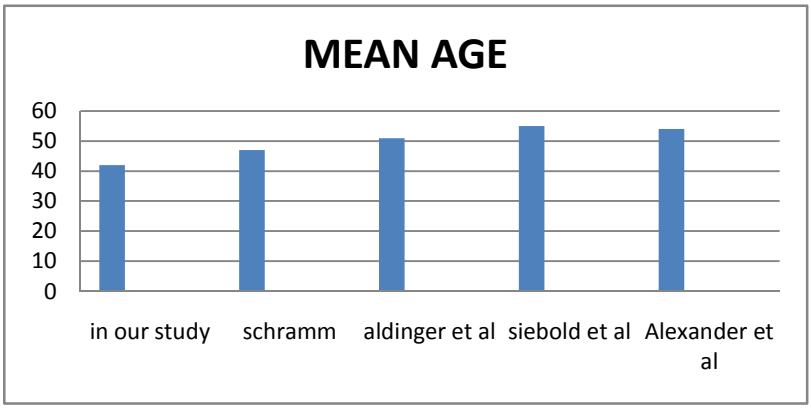


TABLE 2

In our study the most common indication was chronic arthritis

Chronic Arthritis	53.3%
Avascular femoral head	23.3%
Fracture nonunion neck of femur	20%
Dysplastic hip	3.3%

In Alexander et al[66]. Study most common indication is chronic arthritis(89%).

Chronic Arthritis	89%
AVN Femoral Head	8.7%
Fracture neck of femur	0.5%

No case of dysplastic hip reported in this study.

TABLE 3

THE SEX DISTRIBUTION

	Males	Females
IN OUR STUDY	56.6%	43.3%
ChristophRoder et al[57].	53%	46%
Alexander et al[66].	61%	38%

Femoral stem alignment in comparison with other studies

TABLE 4

Optimal position in our study

Neutral	76.6%
Varus	13.3%
Valgus	10%

In R.B BOURNE et al [60]. studythe alignment is

Neutral	95%
Varus	3%
Valgus	2%

Functional outcome in comparison with other studies are:-

TABLE 5

THE POSTOPERATIVE HARRIS HIP SCORE

Poor	6.3%
Fair	20%
Good or excellent	73.3%

The follow up outcome in other studies are:

Schramm et al[23].

Good or excellent - 84%

Fair - 14%

Poor - 2%

Sharkey PR et al[20]

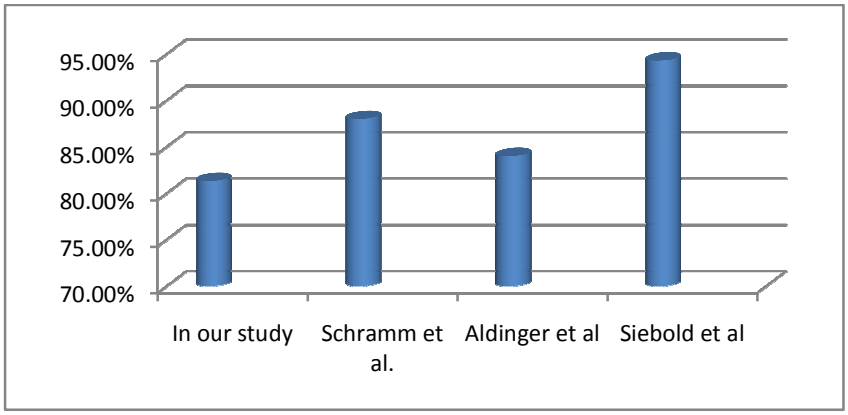
Good or Excellent - 79%

Fair – or Poor - 20%

TABLE 6

Mean postoperative Harris hip score

In our study	81.3%
Schramm et al[23].	88%
Peter Aldinger et al[24].	84%
Siebold et al[26].	94.3%



Reasons for the failure of uncemented total hip replacement as described by other studies

Peter Aldingeret al[24] - High rate of Cup loosening

Sieboldet al[26] - Polyethylene wear with subsequentosteolysis

Aldingeret al[28] - High rate of femoral stem loosening

The incidence of various complications is compared to other studies are

TABLE 7

ASEPTIC LOOSENING OF FEMORAL STEM

In our study	3.3%
Siebold et al[26].	2.3%
Peter Aldinger et al[24].	1.9%
Aldinger et al[28].	3.9%

ACETABULAR LOOSENING

In our study	3.3%
Schramm et al[23].	5%
Alexander et al[66].	1%

Loosening: Radiographs are taken with proper positioning and rotation isneeded to diagnose loosening.

Cement less femoral stem fixation is classified by engh et al.

1. Stable bone in growth
2. fibrous in growth
3. unstable implant

Stages are explained under fixation of implant headings. Subsidence or migration of implant may occur during early postoperative period to attain stable position. In spite of early subsidence stable bone in- growth can occur, but late subsidence lead to unstable implant. Small amount of migration cannot be identified with routine radiographs. Roentgen stereo photogrammetric analysis is used as newer technique. Progressive beads shedding visible on serial radiographs is found to significant. It indicates micro motion at bone stem interface.

Acetabular cement less components

Acetabular cup loosening is rare after uncemented total hip replacement. Loosening of acetabular cup fixation is described by engh at al.

1. stable fixation
2. progressive into unstable
3. definite unstable

Progressing radiolucent lesions indicate unstable implant. Cups with porous coating only have less failure rates. Other than porous coated cups have high chance of failure rates.

Diagnosis of Loosening can be made by serial monitoring of radiographs. Radiolucent area can occur due to infection also. But aseptic loosening can occur before patients present with symptoms.

In these situation progressive monitoring of radiographs are essential. Patients presents with complaints of ‘start – up’ pain that decreased after walking for some distance and also gives history of limb moves outwards and limb becomes shorter. Symptoms with progressive radiological findings confirm the diagnosis. Asymptomatic patients with progressive radiologic findings also need revision surgery as early as possible. Subsidence can occur due to loosening of implants. RSA method is highly sensitive to find small change in position.

Table 8

INTRAOPERATIVE FEMORAL FRACTURE

In our study	6.6%
R.B. Bourne et al[60].	5%
Herzwvrm et al[57].	15.2%

Periprosthetic femoral stem fracture

In our study	Nil
Peter Aldinger et al[24].	0.6%
Guther D et al[25].	3%
Aldinger et al[28].	0.8%

Femur fracture can occur during surgical procedure. Due to weak bone in conditions like osteoporosis and patients with rheumatoid arthritis femur can get fractured while dislocating the hip joint. If dislocation of head is difficult, check for osteophytes and soft tissue contracture. These problems have to be corrected before dislocating femoral head. Protrusion of femoral head and revision procedure are risk factors.

Fracture may occur during broaching or femoral stem implantation. Broach is used for removal of cancellous bone. To remove endosteal cortical bone specific reamers are used. Berry et al.[1] found intraoperative femoral fractures commonly occur in uncemented total hip replacement.

Intra operative – it is classified as

Type A – proximal metaphyseal region

A1- perforation – treated by morselized bone graft

A2- undisplaced crack- cerclage with or without bone graft

A3- unstable fracture- diaphyseal fitting stem and cerclage

Type B – diaphyseal region

B1- proximal to stem tip?- if stable bone graft , if not check for stem if stem not stable go with long stem

or strut graft.

B2 - undisplaced crack – stem stable? - If yes cerclage, if no bone stock go with longer stem and cerclage.

B3- displaced fracture- if stem stable go with allograft cerclage, if stem not stable use longer stem and graft andcerclage.

Type C – distal diaphyseal/ metaphyseal

C1- perforation – bone graft

C2- undisplaced crack – cerclage / strut

C3 - displaced distal fracture- ORIF

Postoperative

The Vancouver classification is

Type A involves the trochanteric region –Greater Trochanter or Lesser trochanter

Type B is the most common type. Fracture occurs at Prosthesis tip or just distal to it

B1 – stem fixed well

B2 – stem loose

B3 – stem loose and proximal femur deficient

Type C Well below the tip of femoral prosthesis

During uncemented total hip replacement if femoral fracture is encountered exposure should be done till the end of fracture is

seen. Then the implant removed. Cerclage wires have to be applied around the fracture site. Wires should be placed distal to the fracture so that further extension can be prevented. Than trial broaching has to be done. Implant reinserted and tension increases in the wires which prevent further displacement of stem.

Fractures can occur after few months or years. Mcelfresh and Coventry described a classification for theses fractures.

1. Stress fractures due to over usage
2. Fractures due to stress risers include other implants
3. Fractures due to violent trauma

The risk factors are heterotopic ossification and osteolysis and stem loosening. Duncan and Masri[(1)] described classification covers location and fixation of stem and the availability of bone stock.

Acetabular fracture

Though it is rare posterior wall fracture is the common site. Most commonly occur in uncemented total hip replacement. Davidson et al.[(1)] described classification for acetabular fracture.

Type I – undisplaced and stable cup

Type II- undisplaced and unstable due to specific fracture pattern

Type III- displaced and requires fixation.

After fixation of acetabular fracture stability should be checked. If cup is found stable cement less cup with augmentation screws are inserted. If cup is found unstable augmentation with antiprotrusio cage should be done. acetabular fracture occurring after 6 weeks should be treated with fixation and antiprotrusio cage. In some cases revision total hip replacement is required.

TABLE 9

SCIATIC NERVE PALSY

In our study	3.3%
Alexander et al[66].	1%

Sciatic, Obturator, Femoral, Peroneal nerves are injured during traction, extremity positioning and pressure from retractors or by direct trauma. The risk factors are dysplastic hip, revision surgery, arthritis, female sex, uncemented fixation and limb lengthening. Risk of sciatic nerve injury is more in revision procedures because the nerve can be caught in scar tissue. Insertion of transacetabular screw in danger zone may damage the nerves. Injury to sciatic nerve can be by prevented careful dissection in dysplastic hip and revision surgeries.

Edwards et al[1] [2].found in his study that limb lengthening of 1.9 to 3.7 is associated with peroneal nerve palsy. Sciatic nerve palsy occurs when lengthening of about 4 to 5 cm. Nercessian et al. found that in his study laceration is only cause rather than lengthening. Eggli et al. in his study found no correlation found between limb lengthening and sciatic nerve palsy. Several studies described postoperative sciatic nerve palsy can be recovered by reduce the lengthening achieved.

Once sciatic nerve palsy developed physiotherapy and foot drop stop splints are given. Late exploration after 6 weeks is indicated for some cases. CT to be taken to know position of screws and cement mass compresses the sciatic nerve. Complete recovery is not common and some residual deficit is expected.

Femoral nerve injury can occur but not common. Can be injured in lateral approach where nerve compressed by retractors used for during anterior capsule reflection and compression by protruding cement. Obturator nerve and superior gluteal nerve are other nerves in danger.

TABLE 10

DEEP VEIN THROMBOSIS

In our study	6.6%
Alexander et al[66].	
DVT	1%
Embolism	1%

It is the commonest cause of death during in first 3month postoperative period. The risk factors include general anesthesia, advanced age, obesity, stroke, myocardial infarction, congestive cardiac failure, hypercoagulable conditions. Deep vein thrombosis occurs during 1st to 2nd weeks of postoperative period. Patients present with leg swelling, erythema, fever, calf muscle tenderness, and positive homan sign. Chest pain and breathlessness can be presented in pulmonary embolism. Venography, duplex doppler ultrasound are used to diagnose DVT. Helical CT, Radio nuclide perfusion lung scan are used to diagnose pulmonary embolism. Prevention can be done with mechanical and chemical methods. Early ambulation and pneumatic pump devices are advised as mechanical methods for the prevention of DVT. Pharmacological methods include use of warfarin, LMWH, Fondaparinaux, aspirin,

enoxaparin. Enoxaparin is commonly used. Monitoring of INR levels, platelets count, aPTT are needed in these situations. Epidural hematoma can occur when enoxaparin used with other toxic anesthetic drugs. ACCP has given guidelines[(1)] for thromboembolism prophylaxis and suggested LMWH, fondaparinaux, Vitamin k antagonist one of them can be used as anticoagulant in special situations. When there is risk of bleeding is present mechanical methods used first followed by use of chemical methods.

ACCP suggested LMWH or warfarin along with mechanical compression devices postoperatively for 10 to 14 days. Aspirin continued for 4 weeks thereafter. For high risk patients, LMWH or warfarin are given for 4 to 6 weeks postoperatively.

TABLE 11

POSTOPERATIVE DISLOCATION

In our study	3.3%
Schramm et al[23].	6.8%
Sharkery PR et al[20].	3.5%

Subluxation or dislocation is due to presence of following risk factors,

a) Revision surgery

b) Faulty position and version of the components

c) Femur impingement on pelvis or presence of residual osteophytes

d) Weak abductor muscle

e) Inadequate tension of soft tissue around hip

f) Nonunion or avulsion of greater trochanter

g) Posterior surgical approach

h) Strenuous physical activity in the immediate postoperative period

Alberton et al[(1)]found that the chance of getting postoperative dislocation is more after excessive soft tissue resection and using a small diameter femoral head and absence of muscle strength. Berry et al. found that surgical approach used influences the outcome of surgery. They reported postoperative dislocation commonly occurs with posterior approach because of difficulty in position the acetabular cup in correct version. While going through the posterior approach methods of preventing postoperative dislocation should be carried out. These are repair of short external rotators and posterior capsule. Posterior approach can be avoided in surgery for patients with muscular weakness and flexion contractures.

Acetabular cup should be correctly positioned in correct anteversion and inclination to prevent postoperative dislocation.

Orientation of patient pelvis to sagittal and coronal plane is assessed correctly by placing the patient in true lateral position. In obese female patients there is a tendency to place the cup in horizontal plane. In thin male patients there is a tendency to place the cup in more vertical position. To prevent placing the acetabular cup in malposition the following methods are used. These are fixing the patient stable in true lateral position, optimal exposure to see the bony landmarks and using anterior superior iliac spine for guide the position of pelvis.

Mclaren et al[(1)]reported a method to measure the degree of anteversion in the plain radiographs. Here the position of anterior and posterior portions of a circular wire is assessed. In cement less cup the orientation of rim is considered. True lateral radiographs and computed tomography can be used to measure the degree of anteversion.

Lewinnek et al[(1)] described an array of angle of inclination and anteversion in which dislocation chance are less. These include 40 ± 10^0 for angle of inclination and 15 ± 10^0 for anteversion. If the cup placed in more vertical superior dislocation may occur during adduction. If the cup is placed in more horizontal posterior dislocation may occur on flexion. In retroverted cup posterior

dislocation occur on adduction. In excessive anteverted cup the femoral head dislocates anteriorly.

The normal femoral neck anteversion is 15^0. Excessive anteversion is seen in dysplastic hip, rheumatoid arthritis. Retroversion is seen in perthe's disease, low cut neck resection. Femoral neck anteversion is assessed by relating the femoral neck with tibia. Anteversion is said to occur when obtuse angle is formed between femoral neck and shaft of tibia. Amuwa and Dorr et al. has given a method of combined anteversion in which computer course-plotting is used. In this method the sum of anteversion of femoral and acetabular component should be in the range of 25 to 50 degrees.

Impingement due to protruding bone cement, protruding implant due to incorrect version, remaining osteophytes and malunion of greater trochanter can cause dislocation. These prominences around implant act as fulcrum by which the implant gets dislocated. Consideration of femoral head size is important in preventing the hip dislocation. Compared to smaller head and head with skirted component, larger diameter head and non-skirted component is more stable. 'Jumping distance' is more for larger diameter head and so impingement range of motion is more for larger diameter head.

Postoperative instructions such as avoidance of extremes of position, positions prone for dislocation are given to the patient and all attending personnel. Precautions measure can vary according to surgical approach used and other factors. Noncompliance to precautions measure is the commonest cause of dislocation in the early postoperative period. Late postoperative dislocation is due to impingent which needs surgical revision.

Dislocation is suspected if patients give symptoms of abnormally rotated limb and pain and limb length discrepancy. Immediate radiographs have to be taken. Once dislocation is confirmed, gentle traction along with slight abduction and specific maneuver have to be done. If patients present after 3 hours general anesthesia may need. Use of image intensifier is valuable in reducing dislocation. During reduction the polyethylene component may be separated from its original position so incongruous alignment between head and acetabular cup seen in radiographs. In these situation open reduction is needed. If reduction is satisfied immobilization for a period of about 6 weeks to 12 weeks with abduction splint is essential. Investigation has to be done to diagnose the above mentioned causes. Surgical treatment like removal of remaining osteophytes, using elevated acetabular rim, exchanging the appropriate femoral head component is needed in

some cases. If abductor muscle paralysis is the cause for dislocation, total hip arthroplasty is exchanged with bipolar hemiarthroplasty. In some cases constrained acetabular socket is used as a last option. As a last option total hip replacement should be avoided in noncompliant patients.

TABLE 12

HETEROTOPIC OSSIFICATION

In our study	3.3%
Schreiner et al[33]	5.7%
Kasetti et al[47]	67.2%

Kasetti RJ et al[47]. Conducted an exclusive study is hetero tropic ossification following Total hip arthroplasty. In his study none of the patients had any recognized risk factors for Heterotopic Ossification and none of the patients had any pharmacological or radio therapeutic prophylaxis against Heterotopic Ossification. He also noted negative correlation between the prevalence of Heterotopic Ossification and postoperative Harris hip score. The incidence and severity of Heterotopic Ossification in anterolateral approach is found to be higher than the posterior approach.

It occurs from a mild form in the region of abductors to bony ankylosis. The increased risk is seen in patients with ankylosing spondylitis and Paget's diseases and other immune disorders.

Anterior and anterolateral approach is related to heterotopic ossification. Cement less fixation is also related to heterotopic ossification formation. These lesions are visible on x ray after 3 to 4 weeks of surgery.

Brookeret al[1]. Classifies extent of lesion:-

Grade I - Presence of Islands of bone

Grade II - Presence of bone spikes in proximal femur and 1cm of space between opposing bone surfaces.

Grade III- Bone spikes with less than 1cm space between opposing bone surfaces

Grade IV- ankylosis

Patients presents with symptoms of pain and restriction of motion.

TABLE 13

LIMB LENGTH DISCREPANCY

In our study	13.3%
R.B. Bourne et al[60].	8%
Herzwvrm et al[57].	17.2%

Limb Lengthening is common and is due to using long neck prosthesis or due to inadequate resection of neck or failure to restore the vertical offset. Lengthening more than 1cm gives discomfort to the patient. Lengthening of more than 2.5 cm is associated with sciatic nerve palsy and limping[(1)]. Contracture release and bony correction is needed in some cases. Correct preoperative planning is essential. Several clinical intraoperative methods have been described. Shuck test is performed by giving traction when limb in extension. Usually release of about 2 to 4 mm occurs. It is subject to vary in some situations. Both femoral offset and vertical offset should be taken into consideration. In some cases soft tissue tension may be restored with the help of over lengthening of limb only. So preoperative planning should be done for obtaining the soft tissue tension without over lengthening.

The reliable method is combined use of preoperative planning and intraoperative measurement [(1)]. Intraoperative methods include measuring the distance between pin placed in the infra cotyloid area and tip of the greater trochanter. In bilateral hip disease limb length is assessed in stable hip. Use of same implants on both sides and same amount of resection is essential. Shortening produces

instability that prone for dislocation. Limb length discrepancy of about 1cm can be tolerated well.

Unacceptable discrepancy has to be investigated and correction treatment is needed. Acetabular cup placed inferior to the tear drop and abnormal version has to be corrected in some cases.

TABLE 14

POSTOPERATIVE INFECTION

In our study	nil
Schramm et al[23].	4%
RB Bourne et al[60].	0.6%

It is disabling complication and removal of implant is needed in deep seated infection. The risk of infection is more in patients with diabetes mellitus, rheumatoid arthritis and other immunodeficiency conditions. Patients with revision procedure, prolonged surgery time, hematoma formed also one of risk factor.

Mechanism of bacterial infection:-

1) Direct route

2) Indirect route from local wound

3) Hematogenous spread from distant site

4) Reactivation of dormant infection.

Safe surgical techniques includes use of double gloves, special gowns, limiting traffic in the operative room, laminar flow systems, gentle handling of tissues.

Tsukayama classified periprosthetic infection into[(1) (2)]

1. Early postoperative: occur within 1st month.
2. Late chronic Infection: occur after one month
3. Acute hematogenous infection: occur after 1month from a distant source of infection.
4. Positive intraoperative culture

Diagnosis of Infection:

Patients give history of continuing pain, fever, wound discharge, swelling in spite of medical treatment. On examination there will be pain with movements, sinuses and erythema. Radiographs show features suggestive of loosening. Progressive loosening and periosteal reaction on radiographs, pseudobursae in arthrography of hip suggests infection. Blood investigation reveals elevated ESR, CRP. ESR more than 30mm/hr and CRP more than 10mg/dl are indicative of infection. It takes a year for ESR and 3 weeks for CRP to return back to normal level. Aspiration can be done under anesthesia with fluoroscopy guidance to identify the organism. 18 – Gauge needle is inserted at a mark just lateral to

femoral vessels or the needle can be inserted laterally just above the greater trochanter tip. Aspirate sent for cell count and culture sensitivity. The diagnosis of infection is made with elevated ESR, CRP levels along with aspirate WBC count 3800 cells/ml. The newer techniques include white cells labeling with indium and technetium sulfur and imaging.

The treatment options available are

1. Antibiotics treatment
2. Debridement and wound wash
3. Debridement and implant exit
4. Revision implantation
5. Arthrodesis
6. Amputation

Early postoperative infection

It can be superficial infection or deep seated infection. Initially superficial infection treated with antibiotics. If wound dehiscence is present aspiration should not be done. Under anesthesia and sterile conditions the wound opened thorough wound wash given[(1)]. Checking has to be done to rule out deep infection. If there is no evidence of deep seated infection wound closed over drain after thorough wound wash. If deep seated infection is present complete exploration of the joint has to be done. If modular component is

used it should be exchanged and implant stability have to be checked. If implant is found to be stable thorough wound wash and debridement have to give. Materials are sent for culture sensitivity and intravenous antibiotics are given for 6 weeks.

Late chronic infection

For eradication of late chronic infection complete debridement has to be done. Through previous incision hip joint exposed and all implants and suture materials and cement components are removed. Thorough wash is given with antibiotic concentrated solution. If needed antibiotic spacer or antibiotic beads can be placed.

Acute Haematogenous infection

It is suspected in when a previously normal patient presents with pain on moving the hip and fever after one month of surgery. Blood investigations such as ESR, CRP are elevated. Aspirate are sent for culture sensitivity and started on appropriate antibiotics. Infection usually occurs due to haematogenous spread from distant source or from bacteremia. Haematogenous infection may occur due to simple invasive procedure such as tooth extraction and dental cleaning. So AAOS advised antibiotic prophylaxis for patients who are at risk of getting infection[(1)]. Antibiotics should be given before any procedure to be done. So that sufficient

concentration of antibiotic in tissues can be obtained to prevent infection. If patient presents within 2 weeks of acute haematogenous infection, it can be treated easily. If loosening is minimal and stability of implant is good debridement with retention of implant is enough. If loosening is more, the unstable implant needs implant exit.

Reconstruction after infection

Before considering arthroplasty after infection following factors have to be taken into account. These are functional status of the patient, eradication of infection, adequate debridement. Next step in planning is when to do the reimplantation. Some suggest revision can be done at time of debridement while others suggest can be done as second stage procedure. Jackson et al[(1)]. reported 84% success rate for a single stage procedure. Here implants are used with appropriate sensitive antibiotic mixed with cement is used. Success is influenced by patient general condition, sensitivity of organism to antibiotics in cement.

The advantages of two stage procedures are follows:-

1) Complete debridement is safeguarded.

2) Eradication of microorganism with antibiotics is attempted.

3) Source of infection can be identified and cleared.

4) Sufficient time to diagnose source of infection.

The disadvantages are:-

1) Long period of hospital stay and disability

2) Economic problems

3) Delay in rehabilitation

In two stages reimplantation antibiotics are given for 8 to 10 weeks after initial debridement. Revision arthroplasty is performed after 12 weeks if ESR, CRP is not elevated and aspiration of hip not showing any organism. Difficulties are encountered due to adhesion and scar tissue, osteoporosis. Trochanter nonunion, sciatic nerve palsy, limb length discrepancy, postoperative dislocations are expected complications. Here acetabulum will be shallow and posterior wall is thinned so it is difficult to identify. The chance of getting ascetabulum fracture is more. Femoral canal preparation will be difficult because of osteoporosis. Fractures are expected and prophylactic cerclage wiring has to be done. If eradication of sepsis is doubted frozen section of biopsy material has to be done. If infection is present, revision arthroplasty is postponed for another 6 weeks. Recurrence of infection after revision surgery results in poor outcome. Though resection arthroplasty is used for eradication of infection it is associated with poor functional outcome.

TABLE 15

OSTEOLYSIS

In our study	6.6%
Schramm et al[23].	8%
RB Bourne et al[60].	11%

It is commonly seen in cemented total arthroplasty and is called cement disease. It is a host reaction to particles produced. The mechanism of osteolysis:-

1. Particles production
2. Migration particles into periprosthetic region
3. Cellular reaction

On the periprosthetic surface membrane, the particles present in clusters. Macrophages react with particulate debris and variety of inflammatory mediators released. These cytokines activates osteoclasts and causes bone resorption. Particles are present in joint fluid. These particles come into contact with bone by joint fluid. So areas of bone not contiguous with articulating surfaces also affected. These areas called as effective joint space. Even tip of the femoral stem and roof of the acetabular cup can be affected due to this pathway[(1) (2)]. Osteolysis of femoral stems commonly occurs in

proximal parts. But non congruent porous coated stems have high chance of getting distal osteolysis. Osteolysis of acetabular components involves the periphery region. Thin polyethylene liner, inadequate fixation are risk factors for getting early osteolysis. In these situations osteolysis commonly occur in the dome of acetabular cup. Debris and particles migrate through holes in the dome of acetabular cup. The progressive osteolysis should be investigated. Radiographs are taken at 3 months and 6 months interval. Big lytic lesion and progressive lysis and loose implant are indication for revision surgery. Some people described bone grafting can be done with retaining the implant. Acetabularosteolysis can be treated by various methods. Liner and head exchange is indicated in mild osteolysis. Acetabular revision with newer modification is indicated in severe osteolysis. In cases of retroacetabularosteolysis curettage and bone grafting is difficult and technically challenging procedure. These regions are approached through hole in the acetabular cup. It has the advantages of 1) the locking mechanism of liner is competent 2) liner can be replaced with full thickness one 3) without removing the cup the lytic areas are approached and treated. In some cases cementing the polyethylene liner is done. It is comparatively stable as compared to that of standard liner locking mechanism.

The other expected complications are

1. Hemorrhage and Hematoma formation: Patients with risk factors should be identified pre operatively. The risk factors are liver disorders, Paget's disease, anticoagulant therapy, bleeding disorders and Gaucher's disease. Bleeding occurs due to injury to obturator vessels and perforating branch of profundafemoris artery, injury to branches of gluteal vessels, vessels near to the anterior capsule. Late onset bleeding can occur after 1 week of surgery due to false aneurysm. Angiography may be required in some situations. Embolization may be indicated in some cases of uncontrolled bleeding. Suction drain is used for cases with increased intraoperative bleeding and in cases with risk of bleeding. It is removed after 24- 48 hrs. Uncontrolled bleeding can lead to hematoma formation. Surgical evacuation of hematoma is needed when wound gaping and nerve palsy and marginal necrosis occurs

2. Vascular injury: Commonly encountered in revision surgery. Obturator vessels can be injured during soft tissue removal from the acetabular wall. Common iliac artery can be injured when over reaming of acetabulum. Transacetabular screws placed

anterosuperiorly can injure the external iliac vessels and when placed antero inferiorly can injure the obturator vessels.

The immediate success of Total hip arthroplasty is determined by the ability of the patient to return to maximum possible level of functional activity. Thus maximum points are given to pain and mobility of patients. Patients with chronic arthritis are incapacitated by pain and restricted motion and thus the relief of these two factors greatly determines the satisfactory outcome of the surgery.

Restoration of the biomechanics of the hip is important for the good outcome and longevity of the prosthesis. In all our cases we tried to restore the centre of rotation, limb length, medial and vertical offset.

We believed that maintaining considerable activity is important for bone remodelling and osteo integration. Only those activities that do not produce considerable joint load such as swimming, cycling and walking are recommended.

The activities that increase the joint load are cross legged sitting, squatting for toilet purposes and any strenuous physical activity. The reason for some of the failures in our study is the

noncompliance of the patient with respect to postoperative counselling.

Pain following Total hip arthroplasty confined to thigh indicates loosening of femoral component and pain in the hip indicates loosening of acetabular component.

The functional outcome was assessed in our study by using the modified Harris Hip Score. Harris hip score is a preoperative and postoperative scoring system designed to assess patient improvement, both objectively and subjectively.

In most of the western studies like Schramm et al, Peter Aldinger et al, Siebold et al, Harris Hip Score was used to assess the functional outcome.

Knahret al[66].considered Harris Hip Score as the best mean of objective evaluation of result of Total hip arthroplasty.

CONCLUSION

- Uncemented Total Hip Replacement to our patients in this study has given encouraging results.
- The short term results of this study show that the noncompliance of the patients during follow up is a significant deciding factor in the functional outcome.
- Our study also shows that lowest preoperative Harris hip score generally results in poor functional outcome.

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S.No	Name	Age	Sex	Diagnosis	DOS	FU PERIOD ON 1.7.2014	IMPLANT		RADIOLOGICAL ASSESMENT (ACETABULAR COMP)	
							ACETABULAR	FEMORAL	OPTIMAL POSITION	LOOSENING ZONE
1	sumathi	38	F	B/L AVN &arthritis	02.08.2012	25 months	ring loc	taper loc	YES	NO
2	raji	38	M	B/L AVN & arthritis	20.08.2012	25 months	ring loc	taper loc	YES	NO
3	devipriya	29	F	B/L AVN & arthritis	12.09.2012	24 months	ring loc	taper loc	yes	no
4	radhika	28	F	B/L AVN & arthritis	04.10.2012	23 months	ring loc	taper loc	yes	no
5	adhikesavan	51	M	B/L avn	09.10.2012	23 months	ring loc	taper loc	yes	no
6	durairaj	42	M	B/L avn	25.06.2013	14 months	ring loc	taper loc	no	no
7	ravi	54	M	# NON UNION NOF	20.08.2013	12 months	ring loc	taper loc	no	no
8	elumalai	35	M	# NON UNION NOF	01.11.2012	22 months	ring loc	taper loc	yes	no
9	peer mohamed	43	M	# NON UNION NOF	09.07.2013	15 months	ring loc	taper loc	yes	yes
10	deena dayalan	28	M	# NON UNION NOF	17.12.2013	10 months	ring loc	taper loc	yes	no
11	lakhsmi paarvathy	45	F	DYSPLASTIC hip& OA	26.12.2013	10 months	ring loc	taper loc	yes	no
12	vijayan	35	M	#NON UNION NOF	12.03.2014	7 months	ring loc	taper loc	yes	no
13	sekar	40	M	avn rt	09.01.2014	9 months	ring loc	taper loc	yes	no
14	sathish kumar	35	M	B/L arthritis	07.11.2013	11 months	ring loc	taper loc	YES	no
15	uma	28	F	B/L arthritis	07.05.2012	28 months	ring loc	taper loc	YES	NO
16	sasikala	45	F	B/L arthritis	09.02.2013	19 months	ring loc	taper loc	no	no
17	ganeshan	47	M	B/L arthritis	01.10.2012	24 months	ring loc	taper loc	YES	NO
18	senthil	45	M	B/L arthritis	01.12.2012	22 months	ring loc	taper loc	YES	NO
19	sulochana	38	F	B/L AVN & arthritis	03.08.2012	26 months	ring loc	taper loc	no	NO
20	jeyanirmala	48	F	B/L AVN & arthritis	12.06.2012	28 months	ring loc	taper loc	no	NO
21	bharathi	54	F	B/L avn	25.04.2012	30 months	ring loc	taper loc	YES	NO
22	diwakar	45	M	B/L avn	18.09.2012	25 months	ring loc	taper loc	YES	NO
23	vennila	40	F	B/L arthritis	12.04.2012	30 months	ring loc	taper loc	YES	NO
24	laxmi	48	F	B/L arthritis	05.06.2012	28 months	ring loc	taper loc	YES	NO
25	pitchimuthu	45	M	#NON UNION NOF	04.12.2012	22 months	ring loc	taper loc	YES	NO
26	devaki	35	F	B/L AVN	02.06.2012	28 months	ring loc	taper loc	YES	NO
27	noorjahaan	50	F	B/L arthritis	03.02.2013	20 months	ring loc	taper loc	yes	no
28	nagappan	45	M	B/L arthritis	28.11.2012	23 months	ring loc	taper loc	YES	yes
29	dharman	47	M	B/L avn	23.02.2013	20 months	ring loc	taper loc	YES	NO
30	vinyagam	45	M	B/L arthritis	21.11.2012	23 months	ring loc	taper loc	YES	NO

S.No	Name	RADIOLOGICAL ASSESMENT (femoralstem)			COMPLICATIONS	LIMB LENGTH DESCREPENCY	FUNCTIONAL ASSESMENT		FUNCTIONAL OUTCOME
		OPTIMAL POSITION	LOOSENING	ZONES			PRE OP HIP SCORE	POST OP HARRIS HIP SCORE	
1	sumathi	varus	no		____	lengthening 1 cm	52	91	excellent
2	raji	neutral	no		_____	_____	55	91	excellent
3	devipriya	neutral	no		____	____	35	65	poor
4	radhika	neutral	no		intraoperative femoral fracture	lengthening 2 cm	46	82	good
5	adhikesavan	varus	_____		____	_____	42	81	good
6	durairaj	neutral	no		____	_____	45	82	good
7	ravi	neutral	no		____	_____	46	82	good
8	elumalai	neutral	no		intraoperative femoral fracture	_____	41	75	fair
9	peer mohamed	neutral	zones 3,4,5		thrombo embolism	lengthening 2cm	44	82	good
10	deena dayalan	neutral	no			____	47	86	good
11	lakhsmi paarvathy	neutral	no		sciatic nerve palsy		38	72	fair
12	vijayan	varus	no		____	shorthening 1cm	45	86	good
13	sekar	neutral	no		____	_____	43	80	good
14	sathish kumar	neutral	no		____	_____	45	82	good
15	uma	neutral	no		_____	____	52	92	excellent
16	sasikala	neutral	no		post op dislocation	____	35	68	poor
17	ganeshan	neutral	no		___	___	45	83	good
18	senthil	neutral	no		thrombo embolism	lengthening 2cm	44	75	fair
19	sulochana	neutral	no		___	___	45	78	fair
20	jeyanirmala	valgus	no		___	___	48	81	good
21	bharathi	neutral	no		___	___	46	84	good
22	diwakar	neutral	no		___	___	45	86	good
23	vennila	valgus	no		intraoperative femoral fracture	___	52	87	good
24	lurdusamy	neutral	no		___	___	45	82	good
25	pitchimuthu	neutral	no		___	___	45	87	good
26	devaki	valgus	2,3,4		___	___	47	75	fair
27	noorjahaan	neutral	no		___	___	45	84	good
28	nagappan	neutral	no		___	___	47	82	good
29	dharman	neutral	no		___	___	39	84	good
30	vinyagam	varus	no		___	___	35	75	fair